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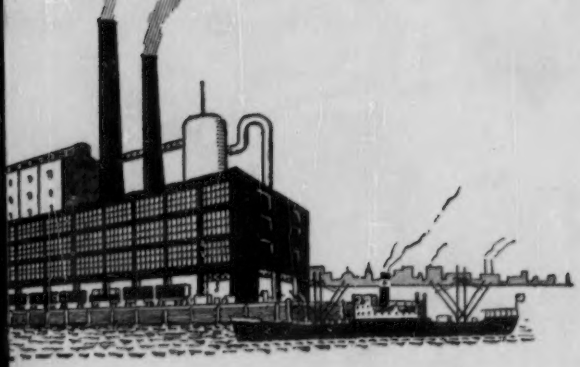

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ECONOMIC GEOGRAPHY

VOL. 31 JANUARY, 1955 No. 1

CHANGING THE MAP OF CHINA*

George B. Cressey

Dr. Cressey is Maxwell Professor of Geography at Syracuse University.

WITH the emergence of Soviet style communism in China, it is natural that the new government should develop a Five Year Plan. Such a program was inaugurated in 1953, but the details are not available. Shortly after the first announcement it appeared that substantial modifications would be necessary, in part because of the over-audacious character of the plans and China's lack of capital and skill to carry them out, as well as because of disappointing prospects for large material aid from the U.S.S.R. While China desires to emulate the Soviet Union and will push her own program to the limit, it is also possible that another objective is to keep ahead of India.

China's first Five Year Plan is presented in terms of Mao Tze-tung's statement that the task is one of "Changing China from an agricultural state into an industrial country, because without industry there can be no solid national prosperity and power."[1] The objectives of the first Five Year Plan appear to be four: (1) to concentrate the main strength on heavy industry; (2) to train personnel, develop transport, light industry, and agriculture; (3) to form agricultural cooperatives; and (4) to reform private industry. The Soviet Union has agreed to "give long-term full-scale and colossal aid" to 141 projects during the ten year period starting in 1949, to be paid for out of the $300,000,000 loan of 1950. These include iron and steel industries, metallurgical industries, coal mines, oil refineries, machinery manufacturing works, automobile works, tractor works, and power stations.[2]

A further parallel between the developments of the first Five Year Plans in China and the Soviet Union may be found in the artificial famine created in the Ukraine when the Russians conscripted grain to pay for imported machinery, and China's export of food to the U.S.S.R. and elsewhere during the 1950's. A letter from Hong Kong in June, 1954, contains the following paragraph:

"Undoubtedly a shortage of food exists and in some areas verges on famine. Natural calamities and the lag

*Presented before the Far Eastern Association, New York, April 14, 1954. Based on the files of *People's China*, *China Reconstructs*, *China Pictorial*, *Far Eastern Economic Review*, *The New York Times*, translations of New China News Agency stories appearing in the China mainland press, scattered references as listed in periodical guides, and assistance from numerous scholars. See also Jean Chesneaux: "La Vie Economique de la Chine Nouvelle," *Annals de Geographie*, Vol. LX, 1951, pp. 88–109; and "Economic Development in Mainland China, 1949–1953," *Economic Bulletin for Asia and the Far East*, Vol. IV, No. 3, 1953, pp. 17–31.

This study is a parallel to the author's "Changing the Map of the Soviet Union," *Econ. Geog.*, Vol. 29, 1953, pp. 198–207.

[1] Mao Tze-tung: "On Contradictions."

[2] Speech by Li Fu-chun before Central Peoples Government Council, New China News Agency, September 15, 1953.

FIG. 1.

in production due to the redistribution of the land are among the causes. But the use of food supplies to buy industrial products is another cause. A statement by two high officials is indicative of the process of translating food into industrial materials (from Russia and her satellites). 'We can obtain 10 tons of thick steel plates by exporting one ton of tea . . . five tons for one ton of pork . . . a tractor for 10 tons of pork . . . 19,000 tons of shelled peanuts will buy an electric plant . . . and one ton of raw silk will bring in enough steel rails to lay one kilometer of railway.' "

As China starts to plan, she should learn the importance of inventory. No wise program of economic development can be laid out until the available resources and the prospective needs are clearly known. The Soviet Union could have saved great sums, perhaps upwards of half a billion dollars, if they had completed the geographic inventory before starting their ambitious program of steel mills and heavy industry.

Fortunately, China has long had an excellent Geological Survey. More is known of China's mineral wealth than is sometimes appreciated, but far more work needs to be done before a nation-wide program can wisely be designed. Information on river flow, soil capabilities, and market potentials is still fragmentary.

Grandiose reports of economic progress frequently appear from mainland China, but it is difficult to evaluate them. In part these represent the consummation of projects long planned and partially completed prior to the Communist period. Significant progress has undoubtedly been made, although at a price, and further changes are to be expected. Given a decade of peace, under whatever government, we may anticipate great developments in China. In places these will be spectacular, with notable achievements in mining, industry, communications, and urban growth. It seems equally probable, however, that China cannot hope to duplicate the material level of Western Europe or North America. China may overtake Japan, dominate Eastern Asia and the Western Pacific, but her resources appear inadequate for world leadership.

This study is limited to political, economic, and social changes which can be located and mapped. Many other developments related to socialist economy are under way, but they are either of diffuse character or locational details are lacking. Only partial data is available in any event, so that the following paragraphs are inevitably incomplete. This is a geographic presentation of recent changes and prospective hopes. The record is necessarily fragmentary and only partially evaluated. Six items are considered: (1) the map itself, with its boundary problems; (2) communications, especially new railways; (3) river control; (4) agricultural changes; (5) shelter belts; and (6) industrial expansion.

BOUNDARY PROBLEMS

Before considering recent changes in the territorial structure of China, it may be appropriate to remind ourselves

as to the former extent of the Chinese Empire. During the Mongol dynasty, nominal control extended to the shores of the Caspian and to Afghanistan, and included at least half of Burma and Indochina. Some influence reached almost to the Aegean Sea and to the Baltic.

Within recent centuries China has lost large areas along her northern frontier to the Soviet Union; areas which are estimated by the Chinese to total 2,114,000 square kilometers. Along the southern border are areas totaling 898,401 square kilometers which were lost to various units of the British Empire. Other territories are now French, or are independent. Areas amounting to 258,692 square kilometers were also transferred to Japan. In all, these "lost territories" total 1,547,500 square miles, nearly half the extent of present-day China. Many of these areas never gave more than nominal allegiance to the court at Peking, but increasing reference to her "lost territories" indicates that they constitute a psychological problem which may some day emerge to form an explosive claim for re-acquisition.

Much of the present boundary of China is in dispute. In the South China Sea, both Nationalist and Communist maps show that China currently lays claim to all island groups between Indochina and the Philippines as far south as latitude 4° N., almost to the shores of Borneo. This includes Pratas Island, the Paracel Reefs, Spratly, and numerous other coral islands. Where China adjoins Burma and Assam, the boundary is in dispute for fully 500 miles, with Chinese claims which extend south from Tibet almost to the Brahmaputra and include the headwaters of the Irrawaddy. In the extreme west, Chinese maps show a boundary which extends well into what is commonly regarded as Kashmir, and also for 200 miles into what Western maps show as Afghanistan. Almost all of the boundary next to the Mongolian People's Republic is in dispute, with a difference between the Chinese claims and the lines shown on most other maps amounting to nearly 100 miles.

The mainland of China under Communist control consists of 25 provinces and two special regions. There is also the Nationalist province of Taiwan or Formosa. Boundary changes have been frequent in recent years. The most recent of these were announced by the Government Council in Peking on June 19, 1954, as reported by the Associated Press on June 21.

Northeastern China, or Manchuria, traditionally included three provinces: Heilungkiang in the north, Kirin in the east center, and Liaoning in the south. To these Jehol was added during the period of Manchoukuo, and the whole area later rearranged into nine provinces. Following the war these became six provinces. Eastern Heilungkiang along the Sungari River was made into Sungkiang province; Liaoning was divided into Liaotung and Liaosi, to the east and west of the Liao River, respectively. Under the decree of June 19, 1954, Liaotung and Liaosi have been merged into the reconstituted Liaoning, and Heilungkiang will reabsorb Sungkiang.

A new Inner Mongolian Autonomous Region was set up in western Manchuria about 1950, not at first related to the traditional area of Inner Mongolia outside the Great Wall. This included parts of western Heilungkiang and Liaoning, and the area was later extended southward into western Jehol. A year ago Chahar was abolished and incorporated into the Autonomous Region except for six hsien, or counties, which were transferred to Hopei; these

included Kalgan and Hsuanhua. A decree of March 4, 1954, also abolished Suiyuan and added it to the Inner Mongolian Autonomous Region. The June 19, 1954, decision added Ningsia province to Kansu.

Under the early years of Communist control there was also a short lived Pingyuan province, formed at the point

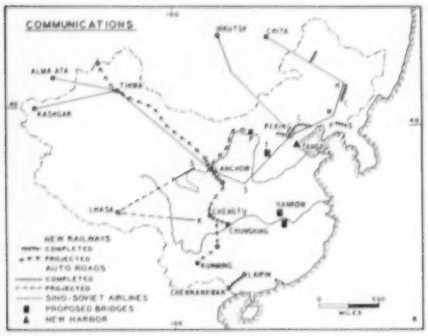


FIG. 2.

where Shantung, Honan, and Hopei meet, and abolished in 1952.

Above the provincial structure were at one time six administrative areas: the Northeast, North China, East China, Central and South China, and Northwest and Southwest Areas. These were abolished on June 19, 1954.

The 25 provinces of 1954 are made up of the original 18, plus the traditional three of Manchuria with Jehol, Sinkiang, and the two provinces of Nearer Tibet. Taiwan makes 26. Eleven cities which once held autonomous municipal status directly under the Central Government, were transferred to provincial control in 1954, leaving only Peiping, Tientsin, and Shanghai under national control.

During 1953 the Communist government conducted a census, as of July 30. Few details are available, but the results as announced on November 1, 1954, are shown in Table I. These figures are far larger than any previous estimates, and should be accepted with skepticism.

TABLE I

POPULATION OF CHINA

Direct investigation	574,205,940
Indirect investigation in minority areas	8,397,477
Taiwan (estimate)	7,592,298
Communist plus Nationalist China	590,194,715
Overseas Chinese	11,743,320
Grand Total	601,938,035

Tibet is a special situation, analagous to but somewhat different from Inner Mongolia for it has not yet been made into an autonomous region. The political area covers only a part of geographic Tibet.

Below the provincial structure there are 58 autonomous administrative districts, defined on ethnographic lines for national minorities. One of these lies in eastern Kirin and is known as the Korean Autonomous District. Several others adjoin Mongolia or Tibet; the largest number reflect tribal variations in the southwest. One of these is the Chuang Autonomous Region in western Kwangsi. This covers an area of 134,000 square kilometers, and includes 8,500,000 people. Within it are 12 non-Chinese nationalities, of whom Chuang people make up 64 per cent of the total population.

COMMUNICATIONS

Better transportation is surely one of China's major needs, and the Communist government is giving it top priority. At the end of 1952, railroads open to traffic were said to total 24,232 kilometers. One through freight train carrying 1222 tons is reported to have covered the 4580 kilometers from Canton to Manchouli on the Soviet border in seven days.

Chinese press reports refer to 12 new railway projects. In the extreme south a 418 kilometer railway was finished in

1951 to link Laipin and Chennankwan, now known as Munankwan, on the Indochina border, thus completing through rail connections from the Soviet frontier in Manchuria to Communist Vietminh.

Two railway projects in Szechwan have received widespread publicity. The 505 kilometer railroad from Chungking to Chengtu was completed in 1952, and is reported to have carried two and a half million passengers during its first year. Along its northward 755 kilometer extension, the Chengtu-Paochi Railroad, 118 kilometers are said to have been completed by the end of 1953. The first of these Szechwan lines has long been planned and much of the earth work was started decades ago. Its completion represents a major engineering accomplishment. The railroad north from Chengtu must cross difficult topography over the Tsinling Mountains, with one tunnel 1600 meters long. When completed it will link Szechwan with the Lung-Hai line and the coast. Survey work progresses for the 810 kilometer railroad from Neichang in Szechwan to Kunming, and construction is expected to begin on the northern section in 1955.

Three new railroads in Kansu are of equal importance. The line from Paochi to Tienshui, 154 kilometers, was destroyed during the war but has been rebuilt. The 346 kilometer line from Tienshui to Lanchow was finished in 1952, and construction is now being pressed westward over the Lanchow-Tihwa line, with 184 kilometers of rail laid by the end of 1953. The line crosses the Hwang Ho over a new 248 meter bridge west of Lanchow, and involves 2500 meters of tunnels in the Wuhsiaoling Mountains 110 miles west of the city where elevations run up to 3000 meters. These tunnels were completed in 1954. Survey work is also

FIG. 3. The railway from Tienshui to Lanchow in Kansu has 46 tunnels and 60 bridges. This bridge 45 meters high crosses the Tiaochiachun Valley. (Courtesy *China Pictorial*, September, 1952.)

reported on the long contemplated 1000 kilometer Paotow-Lanchow line. Should this latter line materialize, Lanchow will become a rail center of some importance.

In 1940 the Japanese built a line southward from Nanning in Kwangsi. It was later destroyed, but has now been rebuilt and terminates at Lungman Harbor, thus giving China a new rail port on the South China Sea.

To the west of Peking, a 105 kilometer line from Fengtai to Shacheng will provide an alternate for the difficult gradients through the Nankow Pass. When completed in 1955, this will allow greatly increased freight tonnage to flow eastward from the new heavy industry centers around Tatung in northern Shensi and Paotow near the Hwang Ho. The long discussed Trans-Mongolian line from Kalgan to Ulan Bator receives occasional mention. North of Peking the railway across Jehol to Manchuria via Hwaichow, Chengteh, and Chinchow, is being rebuilt and realigned.

Manchuria has long had the best railway net in all China. The old Chinese Eastern and Changchun lines are now renamed the Harbin Railway, and the northern section from Changchun to Harbin has been double tracked. Two branch lines have been built into the forest areas. A new railroad in the south is said to link the coal fields of Penchi with Shuifeng on the Korean frontier. Another 30 kilometer mining railroad in Liaotung links Niuhsintai with Tienshuifu.

There is no reference to the partially completed line from Kunming southwestward to the Burma Border. If and when a railroad is available from Yunnan to Rangoon, it will give China a new back door to the Indian Ocean and will raise political questions of considerable import. It now appears to hold a very low priority.

In the field of highway construction, two automobile roads are being pressed toward Lhasa, one from Kangting in the east and the other from Sining to the northeast. Both involve very difficult problems, but a few hundred miles are reported to be open along each route. A third road into Tibet is being built southward from Sinkiang. Many other roads appear to be under construction in western and northern China. A 1954 Communist report gives the total highway system in use as 130,000 kilometers.

Three international air routes of the Sino-Soviet Airlines link China with the U.S.S.R. Each radiates from Peking. The first provides stops at Mukden and Harbin and terminates at Chita. The second flies to Kalgan, Ulan Bator, and Irkutsk. The third route extends southwestward to Sian, and thence northwest to Lanchow, Tihwa, and Alma Ata. A branch line connects Tihwa with Kashgar.

No bridges cross the Yangtze after it leaves Tibet. Construction has long been proposed at Hankow, and work was started in 1953. A 992 foot bridge will cross the Han from Hankow to Hanyehping, and from there a double deck 3762 foot continuous truss bridge will extend over the Yangtze to Wuchang. These bridges will link Peking and Canton, respectively 1220 kilometers to the north and 1102 kilometers to the south.

A new bridge is being built across the Fen Ho at Taiyuan in Shansi. At Siangtan in Hunan, a new 781 meter bridge crosses the Siang River, possibly as the first step in a new Hunan-Kweichow Railway.

The long planned harbor at Tangku, east of Tientsin, was in operation by 1952, with dredging still in progress. Thirty kilometers of breakwater enclose 18 square kilometers. The entrance channel has a high tide depth of 21 feet, while a 28 foot anchorage depth is available inside the breakwater, accommodating vessels up to 10,000 tons.

River Control

The Hwang Ho is not the only river which has brought sorrow to China. Many of her rivers are subject to disastrous floods. Though details are lacking, it appears that there has been an extensive program of reconstruction along many of the 42,000 kilometers of dikes which line her rivers and coasts. Several references deal with the rivers which converge upon Canton, to the Min river above Foochow, to the Han in Hupei, and to rivers in the North.

Along the central Yangtze a large flood detention basin was completed in 1952 west of Shasi, with an area of 921 square kilometers and a capacity of some 6000 million cubic meters of water. Since the Yangtze is known

locally as the Chin Kiang, this name has been given to the reservoir. Two movable dams have been constructed to regulate inflow from the Yangtze and local rivers, and a third is to be built at the exit point. The sluice dam at Taipingkou is 1054 meters long, with 54 movable gates. Another dam at Huangshantou measures 337 meters, and controls flood water from the Yangtze to the Tungting Lake via the Hutu River. North of the Yangtze is the 114 kilometer Chin Kiang Dike.

FIG. 4.

Typical of Communist assertions, whether in China or in the U.S.S.R., is the reference to the Taipingkou sluice gates.[3] "Experts trained in the West believed it impossible to do the work in less than three years. Based on advanced Soviet experience, however, it was shown that it could be done in three months. The Chinese workers and technicians, applying advanced Soviet experience, did it in two and a half! Normal American engineering practice demanded tens of thousands of foundation piles to bear the weight of the 440,000-ton movable dam. It would have taken one and a half years, even with 50 modern pile-drivers, to do this alone. The use of advanced Soviet technique ensures the Taipingkou Dam against sliding."

Farther south, a series of dikes and dams regulate flood conditions along the southern margin of the Tungting Lake. Along the Grand Canal, a new lock on the south side of the Yangtze, 92 by 12 meters, regulates the entrance to the Canal. There is also some indication that the canal on either side of the Hwang Ho, long inoperative, is to be reopened.

The Hwai Ho, midway between the Yangtze and the Hwang, has received the major share of attention. Many of the projects completed during the 1950's have long been in progress, so that some of the credit claimed by the Communists should go to their predecessors. Four detention reservoirs have been constructed in the headwaters of the Hwai, and others are under way along its southern tributaries in Anhwei; there are to be 13 in all with an eventual storage volume of 12,000 million cubic meters. Work was begun in 1954 on the largest of these, the Meishan Reservoir on the Shih Ho, with a storage capacity of 1000 million cubic meters. This involves a 292 meter concrete dam and eventually hydroelectricity. The Poshan Reservoir is on the Chentou River in Honan; it will hold 280 million cubic meters of water. The most advanced is the Futseling Reservoir along the Pi River. This covers 23 square kilometers and has a capacity of 438 million cubic meters. It involves a multiple arch dam 516 meters long and 65 meters high. Some 8000 kilowatts of hydroelectricity are eventually to be produced here.

The terminal lakes of the Hwai, notably the Hungtse and the Kaopao, have also received attention with major dike improvement and the completion of new sluice gates. From the first of these lakes a new North Kiangsu Canal extends 170 kilometers from

[3] Su Ming: "A Victory on the Yangtze River," *Peoples China*, July 16, 1952, p. 29.

Kaoliangchien eastward to Pientankiang on the sea, with provisions for irrigating several thousand acres. From the second of these lakes, access is provided to the Grand Canal by the 697 meter San Ho Dam, with 63 sluice gates and five navigation locks. With these improvements the Hwai will be navigable for 1000 kilometers, and irrigation schemes will eventually supply four million acres.

Several centuries ago, when the Hwai Ho had a normal channel to the ocean and before its lower course was usurped by the Hwang, the Hwai received two tributaries from southern Shantung, the Yi and the Shu. After the Yellow River had deposited so much silt along the lower course of the Hwai, the Yi and Shu could no longer discharge to the Hwai. During their peak flow, large areas have regularly been flooded. New channels to the ocean have now been dug, measuring 180 and 69 kilometers respectively, and both rivers have interlocking control gates which can divert excess water from one into the other.

Three projects along the Hwang Ho are of interest. West of Kaifeng the People's Victory Canal, completed in 1952, diverts some of the flow from the Hwang to the headwaters of the Wei, thus making the latter navigable for 900 kilometers to Tientsin and providing irrigation for 80,000 acres in the western portion of the Yellow Plain. The People's Victory Canal is near Sinhsiang in Western Honan. A large flood detention basin, similar to that along the central Yangtze at Chinkiang, has been developed at Peichinti. If a number of such flood detention basins can be developed in which the excessive silt of the Yellow River will be allowed to settle before the flow continues to the ocean, they may go far toward solving the basic hydrologic problems of the Yellow Plain. Near the mouth of the Hwang, an overflow channel has been constructed at Litsin to prevent the inundation of the lower delta.

Along the Hwang Ho where it swings northward into Inner Mongolia, there are a number of irrigation projects. Due to excessive silting and the easy alkalinization of the soil, most of these have proved unsatisfactory. A new sluice gate at Hwangyang is designed to regulate the flow into one of these old canal systems.

The rivers which converge upon Tientsin to form the Hai Ho have long been a source of trouble. Part of the difficulty arises from the excessive silt content of the Yungting Ho and other streams which come out of the western hills, for the silt content on the Yungting has reached 38 per cent by weight. Tientsin floods also arise from the fact that when the northern section of the Grand Canal was constructed it blocked the course of several east-flowing streams and diverted them northward to the Hai Ho. Both problems are in the process of improvement. Before the Yungting reaches the plain west of Peking, it flows through a narrow gorge. Here has been built the Kwangting Reservoir, largest south of the Great Wall, which covers an area of 220 square kilometers and has a storage capacity of 2270 million cubic meters. The dam is 45 meters high and 290 meters long, and was completed in 1954.

South of Tientsin a new 43 kilometer channel known as the Tiuliuchien Ho has been dug for the Taching Ho, thus relieving flood pressures around the city. There is a 123 meter regulating dam, 44 meters high. This is a project which was started by the Chihli River Commission two decades ago. North of the city another channel improves the course of the Chiaopei Ho.

Near Fushun in Liaoning is the Tahofang Reservoir on the Hun Ho,

where work began in 1953. This involves a 1367 meter earth dam, and the reservoir will have a capacity of 1800 million cubic meters.

South of Tihwa in Sinkiang is the Hungyenchi Reservoir, completed in 1953. It has a capacity of 50 million cubic meters, and will irrigate 26,000 acres.

Other flood control and irrigation projects under way are listed in Kansu, Sinkiang (2), Kwangtung, Anhwei, and Liaoning.

The largest reservoir in China lies behind the Hsiaofengman Dam on the upper Sungari River above the city of Kirin. The dam is 266 feet high, two-thirds of a mile long and holds back 14 billion cubic feet of water. This is an electric project, rather than for flood control.

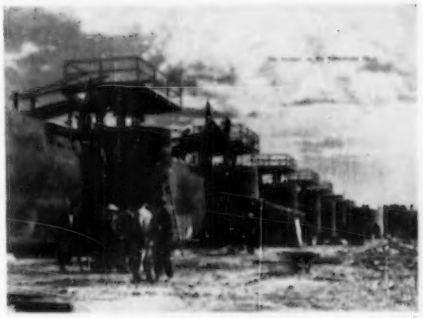


FIG. 5. The Tiuliuchenho Canal south of Tientsin provides flood relief for that city. These movable steel headgates are part of the 123 meter dam that controls the flow. (Courtesy *China Pictorial*, July, 1953.)

AGRICULTURAL CHANGES

Although the Communist government has introduced widespread changes in land tenancy, there is little indication that this would be reflected in an aerial photograph, or that it has much mappable significance. It is interesting to notice that the government aims to almost double its annual grain production within the next ten years, and raise the output to 300,000,000 tons a year. Over 100 million acres are scheduled to be reclaimed in the Northwest.

There are references to 2167 State Farms at the end of 1953, of which 52 were mechanized. Most of these appear to be in areas which are quite unrepresentative of agricultural conditions in general.

While widespread collectivization is the ultimate goal of the Communist government, it is now stressing Mutual Aid Teams and Producers Cooperatives. In these, the land nominally remains in the ownership of the farmer, but there is such a large measure of unified management that cooperatives are close to collectivization.

Seventeen Collective Farms are already in operation, although these again are in areas which are unrepresentative of China's major agricultural problems. One of these lies in southern Kwangtung, the Wanchinsha Collective Farm for Overseas Returnees; another is the August First Mechanized Farm near Tihwa in Sinkiang. Numerous articles describe the first collective farm in China, known as The Spark, and located near Kiamusze on the south bank of the Sungari in Sungkiang province. Other publicized developments are the Tuan Shan-tse Collective Farm in the same province and the Peace Collective Farm in Heilungkiang.

Though much is being written with regard to cultivating new land and adding to the agricultural acreage, it appears that little expansion will be possible without heavy capital investment.

SHELTER BELTS

Dust storms have always characterized the borders between desert and steppe lands the world around, as well as the alluvial plains of rivers in dry regions. When man plows the grass-

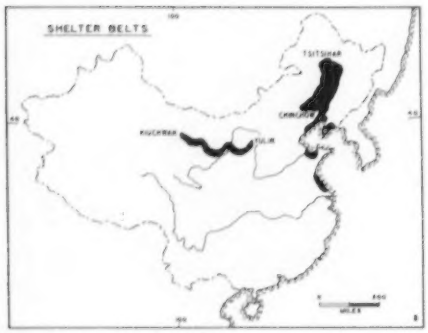


FIG. 6.

lands of semi-humid areas, he destroys the surface protection so that wind erosion develops in areas well away from the true desert. Such has been the case in China, for Chinese farmers, like those in Oklahoma and the Ukraine, have unwisely attempted to convert pasture land into crop land.

It is but natural that Soviet experience with shelter belt planting should be copied by China. Whereas shelter belts will reduce wind velocity and evaporation in their immediate vicinity, their effectiveness beyond a few hundred yards remains open to question. Several very ambitious projects are currently under way, with projected areas of many hundred thousand acres.

In some sections along the Great Wall sand dunes are actively moving to the southeast. These may be checked by proper plantings, although a cover of grass is generally as effective and more suited to the climatic environment. An ambitious program calls for planting continuous rows of trees parallel to the Great Wall from Kiuchwan near its western limit for a thousand miles eastward to Yulin in Shensi. Ten million trees are already reported to have been set out. While certain trees will grow in semi-arid land such as this, if planted in years of favorable rainfall and if watered for the first year or so, it should be recognized that this is an unnatural environment for a forest, and that trees will not reproduce themselves.

The most ambitious shelter belt program lies in western Manchuria where an area 660 miles long and with a maximum east-west extent of 180 miles is to be cross-lined with shelter belts. This extends from the vicinity of Tsitsihar south to Chinchow. An extension will follow the coast from the mouth of the Yalu River south to Shanhaikwan, covering 54,000 acres, with another project continuing to the Lwan River. A 500 kilometer shelter belt is reported to be taking shape in Ningsia.

Several coastal areas north of the Yangtze also have problems of shifting sand. Shelter belt programs are under way along the coast of northern Kiangsu,

FIG. 7. This shelter belt in eastern Honan is a sample of what the Chinese hope to develop in the dusty plains along the Hwang Ho and elsewhere. (Courtesy *China Pictorial*, October, 1953.)

near the mouth of the Hwang, in semi-dust bowl sections of the Yellow Plain in the western parts of Honan and Hopei, and in Fukien along the Min River.

INDUSTRIAL EXPANSION

One of China's announced goals is "to raise the level of industrial production above that of agriculture"; with an eventual goal of 70 per cent of the combined gross output of agriculture and industry. Since prewar manufacturing contributed scarcely one tenth to the national economy, this is indeed a grandiose goal. Communist pronouncements in 1953 placed industry's share as 28 per cent. The objectives further indicate that "in our industrialization the machine building and electrical industries, ferrous and non-ferrous metallurgy, fuel (coal and oil), transportation, and agricultural machinery industry will be given priorities just as they are in the U.S.S.R."[4]

According to preliminary estimates made in early 1954, the production figures compiled from Chinese Communist sources indicate impressive but not phenomenal increases (Table II).

Although the Chinese press is full of glowing reports of industrial progress, few specific details are available. It is clear that the greatest development is in Manchuria where wartime losses and the results of Soviet removal of machinery appear to have been largely restored. Two of the blast furnaces in Anshan, the Number 7 and Number 8, have been rebuilt and are now advertised as "automatic" furnaces. In addition, furnaces 1, 2, and 4 out of the original nine at Anshan are in operation. Only one of the two steel refining plants has been in operation, the other one having been thoroughly stripped by the

[4] Li Chen: "How China Will Industrialize," *People's China*, No. 3, 1953, p. 11.

FIG. 8.

Russians in 1945. All of these existed in pre-communist times. A reconstructed sheet steel mill, a tube mill, and a heavy rolling mill were completed in 1953. Under the Japanese, the Showa Steel Mill at Anshan reached a war-time rated capacity of 1,950,000 tons of pig iron a year, although this was never actually reached. It nevertheless ranked within the dozen largest iron and steel centers of the world.

Output in 1952 was reported at 92 per cent and 63 per cent, respectively, of the 1943 production of 843,000 tons of crude steel and 1,325,000 tons of pig iron. The 1953 production is said to surpass the prewar figure.

Ambitious plans look forward to the enlargement of operations at Tayeh on the Yangtze below Hankow, where the Chinese Communists hope to build up iron and steel facilities rivaling Anshan. Paotow has also been mentioned as the site of a large ferrous metal industry based on deposits of rich self-fluxing ore which the Japanese located during World War II at Pailingmiao to the north.

Another center of growing importance in the steel industry appears to be Taiyuan in Shansi where the works have been "transformed" and now represent a major development, with a new sheet steel rolling mill and a new

TABLE II

ESTIMATED MAJOR PRODUCTION FIGURES OF MAINLAND CHINA*

(In thousands of metric tons unless otherwise indicated)

	Pre-Communist Peak	*1949*	*1952*	*1953*	*1954 Goal*	*1957 Goal*
Coal	52,647	23,691	47,382	49,000	55,286	73,000
Pig iron	1,915	210.6	1,600	1,840	2,116	.....
Ingot steel	1,200	192	1,624	2,112	2,430	6,400
Electric capacity (in thousands of Kw)	2,500	1,800	2,952	3,493	4,000	5,000
Crude oil	330	125.4	449	580	874	.....
Cement	2,600	806	3,489	4,525	4,885	.....
Grain	144,000	109,000	163,750	164,000	169,000	212,800

*Personal communication from Chao Kuo-chun, Center for International Studies, Massachusetts Institute of Technology, May 28, 1954.

heavy machine-building plant. The Chungking Steel Mill has been developed to roll railroad rails. This is a small plant moved up river from Hanyehping during the war.

An article in *Pravda* for October, 1953, lists projected aid from the Soviet Union. This includes reference to steel mills which will be set up on a "grand scale" at Tayeh on the Yangtze, and at Paotow on the Hwang Ho. Tin output is to be doubled at Kochiu in Yunnan, aluminum production is to be increased at Fushun, and ten electric plants are to be built or enlarged.

FIG. 9. The steel mills at Anshan, south of Mukden, are the largest in China. This is a view in the newly rebuilt Automatic Furnace Number Seven, completed in 1953. (Courtesy *China Pictorial*, February, 1954.)

The most important new center of coal mining is at Fuhsin, 110 miles to the west of Mukden, where open-cut operations are expected to exceed the production at the well known Fushun mines east of Mukden. Production has already reached some 5,000,000 tons a year. The coal seam is 60 to 70 meters thick, but operations require the removal of a 20 meter overburden. A new electric power plant utilizes Fuhsin coal.

Though eastern China appears to have negligible reserves of petroleum, the production at Yumen near the western end of the Great Wall is rapidly expanding and will doubtless experience considerable development when reached by the railroad now pushing westward from Lanchow. Production is increasing at Yenchang in northern Shensi, and exploration is under way in Szechwan.

Manchuria has two major centers of hydroelectricity, the Hsiaofangman Dam on the Sungari near Kirin, and the Suiho or Suphung Dam on the Yalu on the Korean border. The dam and power station at the former were nearly

FIG. 10. China's First Five Year Plan calls for thousands of miles of new railways. These rails are in the new finishing shop at Anshan. (Courtesy *China Pictorial*, February, 1954.)

completed under Japanese control. In August, 1945, the United States Paley Commission reported that the Hsiaofengman Project had facilities for eight 70,000 kilowatt units, with a combined capacity of 563,000 kilowatts. At present possibly four of these are in operation. Little is known of the current situation except that the plant is in operation. The even larger hydroelectric development at the 1000 yard Suiho Dam on the Yalu River furnishes power to both Korea and Manchuria, and had a potential listed at 600,000 kilowatts in August, 1945.

Machine industry is expanding in many places. Despite Shanghai's loss of foreign trade, some aspects of its industry seem to be holding their own, for there are many references to the city as the source of equipment for new industries elsewhere. A recent Communist news release credits Shanghai with the production of one-third of all machinery in China. New plants in 1953 include tungsten alloys, gears, and narrow gauge rails.

Major expansion is under way at Harbin and in Mukden. The latter is said to produce one quarter of all the machines made in China. Its location near the coal and iron areas of southern Manchuria makes it somewhat analagous to Kharkov alongside the Donets coal fields in the Ukraine, or to Novosibirsk next to the Kuznets Basin in Siberia. China started work on its first automobile plant in 1953 at Mukden. Harbin, whose population now exceeds a million, is to produce turbine generators, precision instruments, bearings, and a variety of light industrial products such as beet sugar, paper, flax, and woolen goods.

Other cities with new industries are Canton, Wuhan, and Lanchow. Peking

FIG. 11. The Shanghai Electrical Machinery Works is a post war development that is supplying generators for many of the new projects under the First Five Year Plan. (Courtesy *China Pictorial*, February, 1953.)

is being transformed from a purely governmental and cultural city into a significant industrial center, with a steel mill, machine shops and textile plants.

Whereas China's cotton mills were formerly concentrated in the Shanghai area close to imported supplies of raw cotton, important developments are now under way in the cotton-growing areas, with a dozen new mills. Some of the more important centers are Chengchow in Honan, Sian, Peking, Shihchiachuang in Hopei, and Siangtan in Hunan.

It is difficult to know what all of this adds up to, but it is clear that major material progress is under way. China's problems are very different from those of the Soviet Union, and her potentials are more limited, but if this industrial expansion continues for a decade, China will be well on the way toward a significant economic role in Eastern Asia.

TABLE III

URBAN POPULATIONS

City	*Miscellaneous Sources*	*People's Handbook 1950*	*Atlas of People's Republic July, 1953*	*Atlas of People's Republic November, 1953*
Shanghai	6,204,417 (1953)	5,351,810	6,000,000	6,000,000
		4,990,000	5,410,000	.....
Hong Kong (British)	2,250,000 (1954)	.....	.....	.....
Peking	2,030,986 (1951)	1,940,290	2,030,986	2,240,000
	2,768,149 (1953)	.....	2,224,000 (1951)	.....
Tientsin	1,795,292 (1951)	1,785,813	2,000,000	.....
	2,217,564 (1953)	.....	2,010,000 (1951)	2,000,000
Mukden	2,215,600 (1953)	1,551,317	1,551,317	2,000,000
	.....	.....	1,790,000 (1951)	.....
Canton	1,495,694 (1950)	1,120,000	1,500,000	1,500,000
	.....	.....	1,210,000 (1951)	.....
Nanking	1,300,000 (1953)	1,020,000	.....	.....
Harbin	1,200,000 (1954)	.....	.....	1,050,000
Port Arthur, Dairen (Luta)	1,054,465 (1950)	1,054,465	1,054,465	1,050,000
	.....	.....	1,010,000 (1951)	.....
Hankow, Wuchang, Hanyang (Wuhan)	1,608,205 (1950)	1,200,000	1,200,000	1,300,000
	1,200,000 (1953)	.....	1,090,000 (1951)	.....
Chungking	1,038,683 (1950)	980,000	1,100,000	1,100,000
Tsingtao	884,368 (1948)	867,255	.....	.....
Chengtu	749,770 (1948)	.....	.....	.....
Tsinan	642,275 (1948)	532,058	.....	.....
Changchun	630,049 (1947)	.....	.....	550,000
Taipei	503,086 (1950)	.....	.....	.....
	600,000 (1953)	.....	.....	.....
Sian	559,127 (1950)	520,000	560,000	.....
	.....	.....	700,000 (1951)	730,000
Hangchow	517,559 (1948)	.....	.....	.....
Hsuchow	.....	511,860	.....	.....
Fuchow	500,000 (1954)	.....	.....	.....
Anshan	490,000 (1954)	.....	.....	.....
Taiyuan	326,691 (1950)	.....	.....	.....

URBAN GROWTH

The extent of industrial expansion may be indicated by the figures for urban population (Table III). Increases such as these also reflect rural difficulties and the migration of farmers to the cities as well as industrialization.

THE 1953 CENSUS

As of July 30, 1953, the Chinese People's Republic conducted a census in preparation for nation wide elections. Extensive publicity described this as the most complete census ever undertaken in China, but critical evaluation is impossible. Since the totals are more than 100 million larger than any previous estimates, they must be regarded with considerable reserve. The details were announced by the Statistical Bureau on Nov. 1, 1954.[5] Over 2,500,000 census enumerators were employed. A recheck was made on 9 per cent of the population, covering 52,915,000 people and showed duplications amounting to one-tenth of 1 per cent and omissions of two-tenths of 1 per cent.

The direct census count is said to total 574,205,940; in addition there were 27,732,095 people who were added by other means. The grand total numbered 601,938,035. Of the group not actually counted, 8,397,477 represent people in areas without a direct census. Taiwan is credited with 7,591,298 on the basis of 1951 figures, while Overseas Chinese and Students Abroad number 11,743,320 according to the Overseas Affairs Commission. These figures would total 590,194,715 for Mainland China plus Taiwan.

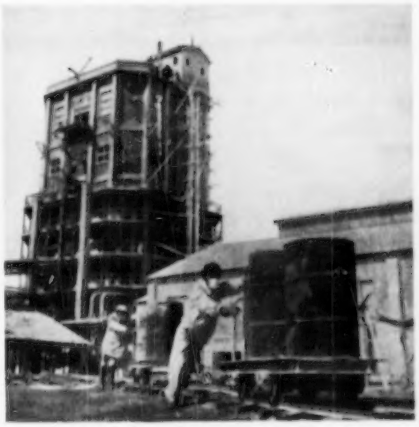


FIG. 12. The Chinese Chemical Plant in northeastern China manufactures caustic soda, bleaching materials, and monochlorobenzene. This Beckmann tower produces bleaching powder. (Courtesy *China Pictorial*, July, 1953.)

TABLE IV

MINORITY GROUPS (1953 CENSUS)

Tung	6,611,455	Tibetans	2,775,622	Pu Yi	1,247,883
Uigurs	3,640,125	Miao	2,511,339	Koreans	1,120,405
Moslems	3,559,350	Manchus	2,418,931	Other minorities	6,718,025
Yi	3,254,269	Mongols	1,462,956		

On the basis of the direct census, males number 297,553,518 or 51.82 per cent, and there are 276,652,422 females or 48.18 per cent. Those 18 years old and more number 338,339,892 or 58.92 per cent. People from 80 to 99 total 1,851,312, and 3384 report an age of 100 or greater; one person is credited with 155 years. People of the Han race, or ethnic Chinese, total 547,283,057, or 93.94 per cent, with 35,320,360 or 6.06 per cent listed under minority groups. Excluding Taiwan and Overseas Chinese, the minority groups numbering over a million are reported as shown in Table IV.

[5] Kwang Ming Jih Pao, Peking, Nov. 1, 1954.

Under the present political organization, three special municipalities are directly administered by the central government. Their populations are as follows: Shanghai, 6,204,417; Peking, 2,768,149; Tientsin, 2,693,831.

Mainland China currently has 25 provinces, with populations as shown in Table V. There are also two special areas, the new Inner Mongolian Autonomous Region, extending from what was once Suiyuan to Western Heilungkiang, and Tibet. The population of Inner Mongolia is reported as 6,100,104 and that of Tibet (with Changtu) as 1,273,969.

TABLE V

POPULATION OF PROVINCES OF MAINLAND CHINA (1953 CENSUS)

Anhwei	30,343,637	Kansu	12,928,102	Shantung	48,876,548
Chekiang	22,865,747	Kiangsi	16,772,865	Shensi	15,881,281
Fukien	13,142,721	Kiangsu	41,252,192	Sikang	3,381,064
Heilungkiang	11,897,309	Kirin	11,290,073	Sinkiang	4,873,608
Honan	44,214,594	Kwangsi	19,560,822	Szechwan	62,303,999
Hopei	35,984,644	Kwangtung	34,770,059	Taiwan	7,591,298
Hunan	33,226,954	Kweichow	15,037,310	Tsinghai	1,676,534
Hupei	27,789,693	Liaoning	18,545,147	Yunnan	17,472,737
Jehol	5,160,822	Shansi	14,314,485		

NOTES ON THE BASIC-NONBASIC EMPLOYMENT RATIO

Victor Roterus and Wesley Calef

Mr. Roterus is chief of the Area Development Division of the United States Department of Commerce. Dr. Calef of the Department of Geography, University of Chicago, is a consultant to the Area Development Division.

THE concept of basic and nonbasic employment and the notion of the importance of the ratio between them arose during the 1930's. It was developed as an analytical tool in the study of cities, primarily the study of cities for planning purposes. During the ensuing years, however, interest in the concept has become increasingly widespread among planners, economists, geographers, and others concerned with areal matters (particularly urban areas) as evidenced by a gradually increasing volume of studies oriented around the concept[1] and by the lively discussions centering on the basic-nonbasic concept at the last two national meetings of the Association of American Geographers.

Some studies done recently by the authors in connection with the work of the Area Development Division of the U. S. Department of Commerce have led us to some conclusions as to its use as an analytical device for the study of areas. They form the body of these notes.

First of all, we may note that the basic-nonbasic employment ratio has meaning only for a definitely circumscribed area. It is a conceptual device for the study and presentation of certain limited aspects of the economic life of a definitely delimited area, and any data which we may create (not discover) for any delimited area may change, chameleon-like, if the area is delimited differently. The notion of a definitely circumscribed area is of course, inherent in the very definitions of basic and nonbasic. Roterus in his study of Cincinnati defined basic employment as that which produces goods and services for export beyond the adopted area. Although some minor variations in terminology have subsequently been suggested, export employment is still the guide to defining basic employment.

The relationship of basic-nonbasic employment to areal delimitation can be made most sharp if we consider the actual process of establishing such a ratio in detail.

Since the basic-nonbasic employment ratio has been almost universally applied to cities, we will begin by extending the reasoning logically to an extreme case. Let us assume a cross-roads hamlet—consisting of a tavern, a filling station, and a grocery store—whose market area is the township. Let us assume further that none of the business owners or their employees trade at any of the other hamlet stores. If we calculate the basic-nonbasic employment ratio we discover that all the gainfully

[1] A spate of recent articles includes: Homer Hoyt: "Homer Hoyt on Development of Economic Base Concept," *Land Economics*, Vol. 30, 1954, pp. 182–191. Richard B. Andrews: "Mechanics of the Urban Economic Base." *Land Economics*, Vol. 29, 1953. John Alexander: "The Basic-Nonbasic Concept of Urban Economic Functions." *Economic Geography*, Vol. 30, 1954, pp. 246–261. The Hoyt article contains citations to numerous other studies involving the concept.

employed represent 100 per cent basic employment; they must, because they all export goods or services from the delimited area. Let us further assume that all other employed people in the larger township area are dairy farmers whose production is sold entirely outside the township. If we take the township as the area of consideration, and again calculate the basic-nonbasic employment ratio, we discover, of course, that the farmers all represent basic employment, but our hamlet businessmen have now become nonbasic workers, because they furnish goods and services to the basically employed farmers. Let us assume further that there is a large city in the county and that all the farmers in the township are dairy farmers who sell fluid milk in the city. If we adopt the county as our study area and calculate our basic-nonbasic employment ratio, we find that our basically employed dairy farmers have now become non-basically employed because they furnish goods for the basic workers of our newly delimited region.

It becomes apparent by proceeding as we have that the numbers of nonbasic employees increase as the size of our delimited area increases. If we take the United States as our circumscribed unit, the ratio of basically employed to nonbasic workers becomes very small, because only workers producing for export out of the country would be basic employees. Clearly the basic-nonbasic proportion is not an absolute; it is a heuristic device for expressing certain relationships.

It has been noted repeatedly that the basic-nonbasic ratio "seems" to show an increase in the proportion of nonbasic workers as the size of cities increases. All the empirical studies indicate this to be the case. However, if the foregoing account of the process of making such employment analyses is correct, we should be astonished if that were not the case. It is a commonplace to state that large cities perform functions for themselves, that smaller cities do not perform for themselves. Clearly, a larger city would have a greater proportion of its employed persons furnishing goods and services for each other than would a small city.

The basic-nonbasic employment ratio then, is a measure of the degree of economic interdependence existing between the people of a circumscribed area and of persons in all other areas. As the size of the area increases, *ceteris paribus* (including such factors as income levels, level of business activity, and cultural levels), the degree of interdependence will decrease.

Whether or not the basic-nonbasic employment ratio is a particularly effective or comparatively crude measure of this interdependence relationship has not been investigated widely. Difficulties in the application of the ratio have been discussed sufficiently so that they are fairly clearly understood. The comparative usefulness of some wholly different measure (such as commodity or monetary flow) needs to be investigated.[2]

What is important here, however, is that the economic base concept is simply a descriptive tool; quantitatively descriptive to be sure, but still merely a description of certain *limited* aspects of the economic functioning of a city or a region. Because it is simply a descriptive device one wonders what purpose is served by elaborate schemes of data collection for the purpose of attempting extremely accurate proportioning of the employed population between basic and nonbasic groupings. On *a priori* grounds

[2] All the matters mentioned in this paragraph and other closely allied issues are discussed in detail in Richard B. Andrews, *op. cit.*, p. 164–172.

we would expect, and published studies confirm, that the ratio will vary with city size, and with numerous other circumstances of cities of the same size. For example, a radio plant in Cincinnati may sell 80 per cent of its output outside the metropolitan area one year, and the next year at almost the same level of output and employment sell 70 per cent locally owing to model and consumer preference changes. The Federal Reserve study of Wichita demonstrated the same fact on a city-wide scale.[3]

It appears to us that the important elements in the basic-nonbasic concept are the notion of the multiplier effect or growth-inducing influence of basic (export) industry and the space relationships aspects so persuasively pointed out by Alexander.[4] The recognition of these relationships certainly represented a major advance in both theory and practice of urban analysis and planning. "The distinction is useful primarily to indicate the process in urban growth."[5] Neither of these functions of the ratio demands a close determination of the exact ratio in order to accomplish effectively the purposes to which the ratio can be put. To use it in other than a gross way gives a false certitude to its use.

Hoyt's recent article[6] gives two excellent illustrations of our point here. He suggests that the ratio is peculiarly applicable to estimates of future population growth and land use requirements, by giving examples from his own work. In speaking of his population forecasts he says, "Accordingly I took trends of past (Basic Industrial) growth as an indication of future growth unless I found reasons to expect a reversal of the trend." Again, he predicted land use requirements "by taking estimated future employment in each type of manufacturing" and relating it to known space requirements. Hoyt is absolutely right in his implication that the use of a multiplier factor (which grows out of the basic-nonbasic idea) will give a more rational prediction of future population or future space requirements than would be made without such a factor. However, it is perfectly clear that the accuracy of his population predictions rests ultimately on the accuracy of his analytical guesses about (a) the future structure and size of industry in the community and (b) the future basic-nonbasic ratio. Note that we have said more rational, not more accurate. It is easy to imagine situations in which the use of the multiplier factor would increase the predictive margin of error. Basic-nonbasic relationships are so expensive to compute precisely, are subject to so much variation from place to place, and, especially, over different periods of time, that the ratio is best utilized as a crude general measure. Wherever the concept appears to have utility in prosecuting study or planning of an urban area it will best be used as a rough, approximate measure of the relationship. Elaborate precautions to establish the ratio with great accuracy will lead to false notions concerning the stability of the findings; but, more importantly, will not repay the effort expended so well as a similar time expenditure along other lines of investigation.

Another point seems worthy of comment. There is universal agreement that the terms "basic" and "nonbasic" do not imply differences in the relative importance of the two types of activity. Nevertheless, we suspect that there

[3] "The Employment Multiplier in Wichita," *Monthly Review*, Federal Reserve Bank of Kansas City, Sept. 30, 1952.

[4] John Alexander, *op. cit.*

[5] Victor Roterus, Cincinnati Metropolitan Master Plan Study "Economy of the Area," Cincinnati Planning Commission, 1946.

[6] Homer Hoyt, *op. cit.*

exists a mental construct which, in fact, construes a greater significance to "basic" than to "nonbasic." We quote from a current article,[7] though scores of similar quotes are available. "The support of a city depends on the services it performs not for itself but for a tributary area. Many activities serve *merely* the population of the city itself." And again, "the inhabitants of . . . towns could not be expected to live by taking in each others' washing."

The first quote undoubtedly reflects an aspect of our national economic life, but to mentally structure our national economy in this way is quite like focussing on the flea and ignoring the elephant on which it rests. With a national income of $305 billion last year, and with farm income representing only about a twentieth ($16.1 billion) of total national income, we think, nevertheless, that there is a stereotype that visualizes an heirarchical economy with agriculture at the base, small settlements serving agriculture, larger settlements serving smaller settlements, etc. Granted that this is an aspect of our economic structure, the foregoing income figures seem to indicate that it is no longer the fundamental structure. By far the greatest portion of our economy does consist of urban dwellers making their living by "taking in each others' washing." The only way to escape this conclusion is to assign a more "fundamental" aspect to certain functions in our economy than to others; a point of view which all proponents of the basic-nonbasic ratio have been at pains to disclaim. Much more could be said on this point, but in the interests of brevity we will hope that the outlines of the idea are clear.

[7] Alexander, *op. cit.*

INTERNAL STRUCTURE OF THE CBD*

*Raymond E. Murphy, J. E. Vance, Jr., and Bart J. Epstein***

IT is a matter of common observation that the Central Business District (CBD) of the American City is not a uniform area. Everyone knows that the tallest buildings and the greatest crowding of pedestrians occur somewhere near the center, and that there is a less intensely used belt grading away from the central area. Most people are aware, too, of a rough sorting into districts in the CBDs of larger cities—a group of department stores here, a cluster of theaters there, and a number of banks in still a third area. Such elements of the District's pattern and others that will be mentioned later constitute what is here called the structure of the CBD, the subject of this article.

It is not our purpose here to examine the structure of individual CBDs, however interesting such a subject might be. To a certain extent, some of these possibilities were brought out in the two earlier papers where the nine CBDs —Worcester, Massachusetts; Grand Rapids, Michigan; Salt Lake City Utah; Tacoma, Washington; Sacramento, California; Phoenix, Arizona; Tulsa, Oklahoma; Mobile, Alabama; and Roanoke, Virginia—were delimited and compared.[1] It is our intention in this paper to consider the internal arrangement of features common to all CBDs, insofar as this can be done from a study of only nine cities of a limited size range. In short, we are attempting to present a tentative structure of *the* CBD.

Actually, the difficulties inherent in analyzing and explaining the internal structure of a typical CBD are enormous, and the results presented here are considered by the authors as little more than a beginning. But an understanding of the structure of the District is so important that a start must be made. Indeed, it is through progress in this direction that the answers to many practical problems facing cities may come.

Factors of Internal Structure

The areal variations by which internal structure is expressed are based on a number of factors. There is the basic aspect, land values, which underlies the whole matter. And there is that most readily observable aspect, land use, which is, in considerable part, a city's adjustment to land values.

*This is the third of a series of three articles on the Central Business District appearing in successive issues of the magazine and presenting the results of a research project supported by the Geography Branch of the Office of Naval Research. For acknowledgments of assistance from various individuals see the first article, which appeared in the July, 1954, number. The three articles on the Central Business District are now available under separate cover, with a bibliography and with an appendix giving land use data in greater detail than has appeared in the articles.

**Mr. Epstein, who did the statistical work for the land use analysis based upon the walking-distance zones, is now on the staff of the Marketing Research Department, Stop & Shop, Inc., Boston, Mass.

[1] Raymond E. Murphy and J. E. Vance, Jr.: "Delimiting the CBD," *Econ. Geog.*, Vol. 30, 1954, pp. 189–222; "A Comparative Study of Nine Central Business Districts," *Econ. Geog.*, Vol. 30, 1954, pp. 301–336.

But there are a number of other factors, too. Street patterns and block sizes are important, since they constitute, in a sense, the framework of the District; and building heights, for they form the basis for studying variations in vertical extent. Then there are variations in such aspects as central business height and central business intensity, which can be calculated from land use maps and were discussed at length in the first two papers. And there are dynamic aspects of structure: traffic flow, pedestrian flow, the vertical movement of people in tall buildings, and the flow of communications.

Of course, not all these aspects of structure (or still others that might be added) can be covered in this paper. Field time did not permit the investigation of many of them. Moreover, some of the aspects of structure, though they can be expressed for a single city, are difficult to reduce to an average pattern, which is the objective here. We are not interested, it must be remembered, in internal variations within any single CBD, but in internal variations within the average CBD.

LAND VALUES AND CBD STRUCTURE

Underlying the internal structure of the CBD and in many ways helping to determine this structure are land values, but data on land values are not readily available for all cities. The study of land values presented here is based on only six of the nine cities—Worcester, Grand Rapids, Salt Lake City, Tacoma, Sacramento, and Phoenix. For each of these cities, front-foot values by lots were obtained.

The difficulties of comparing land values of one city with those of another were pointed out in the first article of this series,[2] and a method was discussed of drawing a "5 per cent line." This line encloses the area with front-foot values amounting to 5 per cent or more of those of the peak value lot. In the same article, it was pointed out that the 5 per cent line, though not exactly coinciding with the edge of the CBD, was found to come remarkably close to doing so (Fig. 1). Land values in the CBD, therefore, may be considered to range from the peak value down to about 5 per cent of that amount at the District's edges.

Other percentage lines were drawn on the same basis as the 5 per cent line. In this manner eleven land value classes were determined: one extremely small one consisting of the lots having peak valuation (100 per cent); one made up of lots amounting to at least 5 but less than 10 per cent of the peak value; and the remaining nine dividing the values between 10 and 100. For each of these 11 classes the total acreage in the six cities was measured and combined (Table I).

TABLE I

A LAND VALUE CLASSIFICATION OF THE AREA WITHIN THE 5 PER CENT LINE

Land Value Class (Per Cent of Front-foot Value of Peak Value Lot or Lots)	*Total Area within Each Class for the Six Cities Combined (in Acres)*	*Mean Area within Each Class for Average City (in Acres)*	*Percentage of Total Area in Each Class*
100	1.30	0.22	0.37
90– 99	2.77	0.46	0.79
80– 89	0.69[a]	0.12[a]	0.20[a]
70– 79	5.88	0.98	1.68
60– 69	8.71	1.45	2.49
50– 59	7.49	1.25	2.14
40– 49	15.09	2.52	4.55
30– 39	18.36	3.06	5.25
20– 29	26.73	4.46	7.65
10– 19	108.10	18.02	30.94
5– 9	153.58	25.59	43.94
	348.70[b]	58.13[b]	100.00

[a] If data were available for more cities, it is probable that this class would be found to fall in line with the others.

[b] These are not comparable to gross areas for CBDs as given in the second article of the series because gross area figures include the area of streets.

[2] Murphy and Vance: "Delimiting the CBD," *op. cit.*, pp. 197–200.

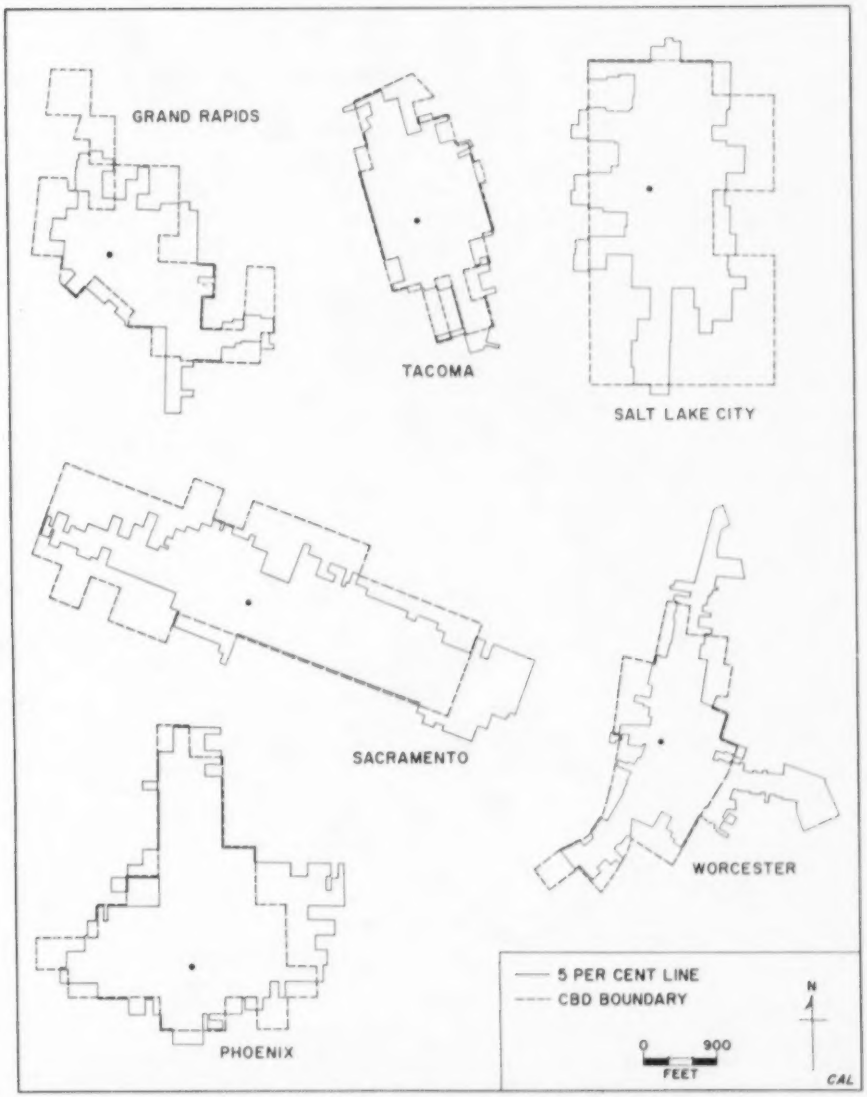


FIG. 1. In the six cities for which land value data were obtained, the 5 per cent line, though not coinciding with the CBD boundary based on land use, generally did not depart from it very far. The drawing of the 5 per cent line (enclosing the area of the city with front-foot values amounting to 5 per cent or more of those of the peak value lot) and other lines for higher percentages presented numerous problems. In places, successive land value lines coincided; in others, lots intervened that were public land and hence had no valuation. Subjective judgments frequently were involved. Because of these difficulties no attempt has been made to show the full series of land value lines. The dots represent the peak land value intersections.

When these data are reduced to percentage values, as they are in the fourth column of the table, some interesting facts become apparent. Perhaps the most striking is that three-fourths of the area within the 5 per cent line is valued at less than 20 per cent of the peak value. Only a little more than 8 per cent is valued at as much as half the peak value. In other words, land values decrease rapidly at first as one leaves the peak value intersection, but this decline becomes less and less rapid toward the edges of the District. The average curve of decline is somewhat irregular but clearly concave. The situation can be summed up by saying that land values decrease at a decreasing rate with distance from the peak land value intersection.

Of course these facts apply to an average, and as such assume a symmetrically shaped CBD. This is rarely the case, and there is a tendency for the successive percentage lines roughly to parallel the outline of the District. In an elongated CBD the rate of decline is much lower along the axis of the District than at right angles to the axis.[3]

Since so much of the discussion on land values of the CBD depends upon the location of the peak value intersection, calculations were made to determine the relative locations of this critical point and the geographic center of the District (Fig. 2). In every case the peak value intersection is found to be located within a few hundred feet of the geographic center. And an additional interesting fact is evident. In most of the cities studied the geographic center is located in the same direction from the peak value point as the area of the greatest CBD expansion (Fig. 16). This suggests that the peak value intersection does not keep pace with the CBD's gradually shifting position.

[3] In this connection see the 5 per cent lines on Figure 1; see, also, Charles M. Downe's boundary of the Worcester CBD and of the Hard Core of the District based on land values, reproduced as Figure 2 in Murphy and Vance: "Delimiting the CBD," *op. cit.*, p. 193.

LAND USE AND CBD STRUCTURE

Among the many possible bases for investigating the structure of the CBD, land use is by far the most valuable and practicable. Land use is readily observable and mappable, and reflects, better than any other aspect, the processes at work in the CBD. Moreover, it is relatively easy to analyze land use variations on maps, and to average the data of individual CBD maps in such a way that a composite pattern for the group of Districts studied can be obtained. Because of these advantages, land use data have been used here as the chief basis for studying the internal differentiation of the CBD.

Distance Zones and Land Use Analysis

The first step was to develop a method of analyzing the District's land use both vertically and horizontally. As a basis for studying the arrangement of land

TABLE II

LOCATION BY ZONES OF THE HIGHER BUILDINGS IN THE CBD

	Ratio of Total Floor Space at Sixth Floor Level and Higher to Ground Floor Area of the Zone			
	Zone 1	*Zone 2*	*Zone 3*	*Zone 4*
Worcester	.03	.67	.26	.26
Grand Rapids	.17	.70	1.41	.49
Salt Lake City	.67	.25	.06	.16
Tacoma	.11	.33	.33	.57
Sacramento	.39	.13	.16	.12
Phoenix	.00	.16	.42	.22
Tulsa	1.02	2.08	1.16	.85
Mobile	.00	.37	.28	.00
Average for eight cities	.30	.59	.51	.33

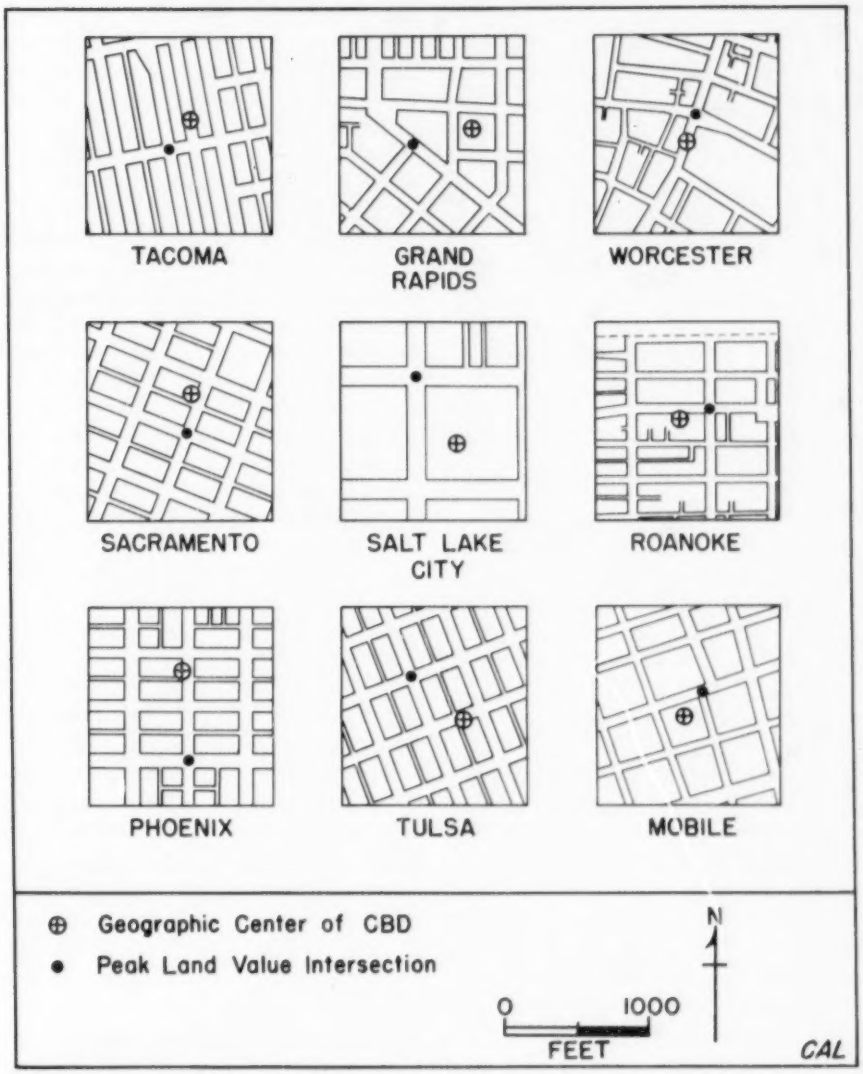


FIG. 2. The peak land value intersection is nowhere more than a few hundred feet from the geographic or areal center of the CBD. Compare with Figures 6–14 in first article of this series and with Figure 16 of the present article. In most cases the geographic center lies in the direction from the peak value point in which maximum growth of the CBD is occurring.

uses,[4] a pattern of four walking-distance zones was developed. Zone 1 is the area surrounding the peak land value intersection, nowhere exceeding 100 yards walking distance along intersecting streets from the center of this intersection. Zone 2 is 100–200 yards walking distance from the same central point; Zone 3 is 200–300 yards; and Zone 4 is 300–400 yards.[5] Obviously, Zone 1 is a solid, compact area surrounding the peak value intersection, and the other zones are merely belts of land surrounding Zone 1.

The pattern of zones for each city was drawn on acetate paper and used as an overlay on the land use maps, thus making it possible to tabulate the use data by distance zones, and, at the same time, to calculate areas of use units. In the analysis, each establishment was considered to lie completely in the zone in which it fronted; in questionable cases preference was given to the lower-numbered zone.

Only eight of the nine CBDs were included in the analysis. The mapping in Roanoke was done in October, 1953, several months after completion of the field work in the other cities and too late for Roanoke's CBD to be included.

The information resulting from the map analysis of the eight CBDs is presented graphically on a percentage basis in Figures 3-11. Note that in every instance the land uses represented by the columns are divided into three groups—Retail Business; Service-Financial-Office; and Non-central Business—and that these groups in turn are broken down into use types (see footnote 4).

As a first step we may consider how land use varies with distance from the peak value intersection. Since we are primarily concerned with the average city, the discussion will deal chiefly

[4] The classification used here includes three major groups. These in turn are subdivided into use types, most of which are broken down still further into specific land uses. The details of the classification are as follows:

RETAIL BUSINESS USES. *Food:* restaurant; supermarket; general food; food specialty; delicatessen and ice cream parlor; package store; bar; *Clothing:* women's clothing; men's clothing; family clothing; clothing specialty; general shoe store; men's and women's clothing; *Household:* furniture; hardware and appliances; dry goods, rugs, curtains, etc.; coal, oil, ice, and heating sales; used furniture and antiques; *Automotive:* sales of motor vehicles, new and used; service station or garage; accessory, tire, and battery sales; automotive rental; *Variety:* department store; "5 and 10" store; drug store; cigars and news; *Miscellaneous:* sport, photo, hobby, toy, etc.; jewelry and gift; florist shop; book store; office machines and furniture; office supply and stationery; pawn shop; amusement establishment.

SERVICE, FINANCIAL, AND OFFICE USES. *Financial:* bank; personal loan; insurance agencies and real estate offices; brokers; etc.; *Service Trades:* personal service; clothing service; household service; business service; newspaper publishing; *Headquarters Office; General Office; Transportation:* railroad uses; bus uses; air transport; trucking; *Parking:* customer parking; commercial parking; *Transient Residence:* hotels and other transient lodging.

NON-CENTRAL BUSINESS USES. *Residential:* permanent dwelling units; *Public and Organizational:* public building space and public ground space; organizational and charitable institutions; *Industrial; Wholesale* (not including wholesale offices separate from wholesale establishment); *Vacancy:* vacant building or store; vacant lot; commercial storage. (Commercial storage makes up such a small fraction of the total of this last type that it is disregarded in the land use discussion.)

[5] The peak land value intersection was taken as the point of origin of the walking-distance zones. All streets (not including alleys) were bisected, and lines were drawn through the midpoints, yielding junctions at every street intersection. Starting from the intersection at the peak point, a distance of 100 yards was measured on each mid-street line radiating from the peak point. Then a point was marked and perpendiculars were dropped to the edges of the blocks on each side of the street, in order to obtain land use intercepts. Where a street branched off before the 100-yard distance was reached, measurement was continued along that street, too, and where 100 yards distance from the peak land value intersection was reached, perpendiculars were dropped to the edges of the blocks as before. To complete an outline of Zone 1, diagonals were then drawn across blocks between adjacent block intercepts. Similar procedures yielded Zones 2, 3, and 4, representing 100–200 yards, 200–300 yards, and 300–400 yards walking distances, respectively.

A certain amount of the CBD of each city lies beyond the 400-yard walking distance. The analysis presented applies only to the area within 400-yards walking distance of the peak value intersection, and only to that part of the area so described that is within the CBD.

with Figure 3 which represents an average for the eight Districts.[6] Section I of Figure 3 shows an average of all floors by zones.

The First Hundred Yards.—In many respects the first 100-yard zone, the area immediately surrounding the peak land value intersection, is the most interesting portion of the CBD as it represents the quintessence of those characteristics that are associated with the District. This concentration is reflected in the great numbers of people on the streets and in the high valuation placed upon the land. Though no exact correlation between distance zones and land value classes (Table I) is possible, it must be remembered that the highest land value classes occupy very limited areas. Zone 1 probably includes, on the average, most of the lots in the classes over 60 per cent.[7]

It might be thought that in this zone the tallest buildings would be concentrated, but an analysis of the location of floor space at the sixth floor level and higher in the eight cities shows that this is generally not the case (Table II). Only two of the eight CBDs show a concentration in Zone 1.

Turning more specifically to land uses, we may consider first the relative importance of the three groups in Zone 1 (see first vertical bar of Section I, Fig. 3). Retail Business uses predominate, occupying more than half of the space. The Service-Financial-Office group is second in the proportion of space occupied; and the Non-central Business group is third, accounting for

[6] For variations in gross CBD land use from city to city see Murphy and Vance: "A Comparative Study of Nine Central Business Districts," *op. cit.*, pp. 331–334.

[7] The difficulties of correlating distance zones and land value classes become apparent when one considers that the distance zones tend to be roughly symmetrical whereas the land value lines tend to reflect the outline of the district. In this connection see page 24.

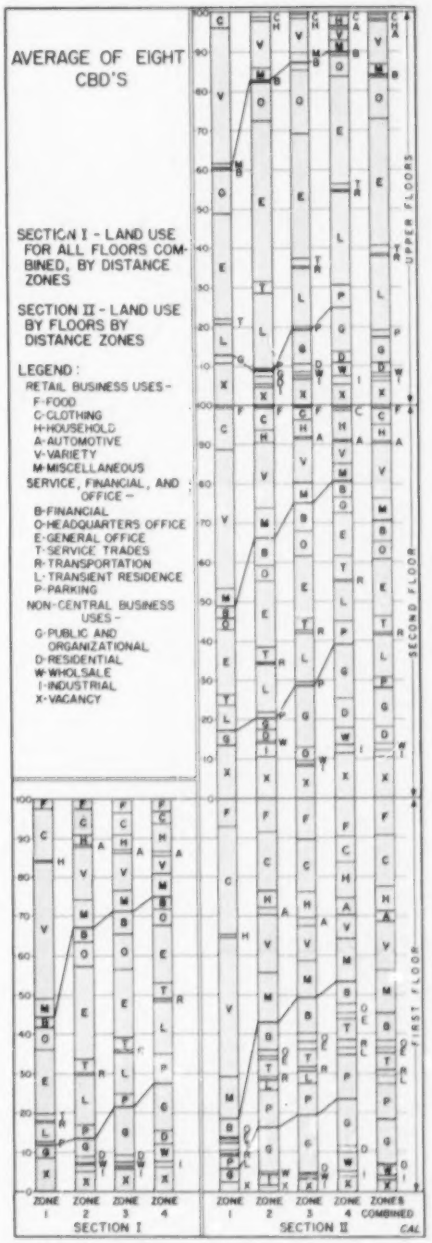
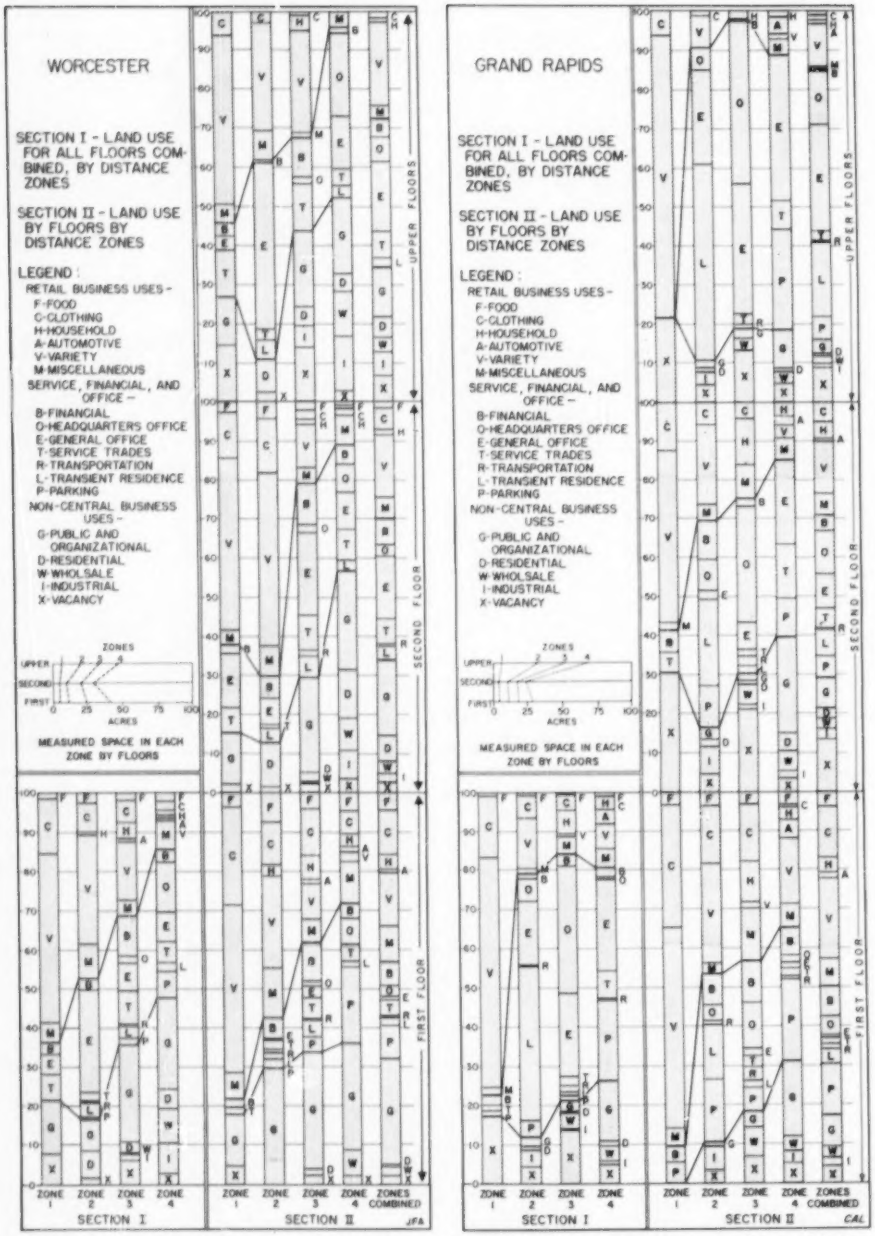
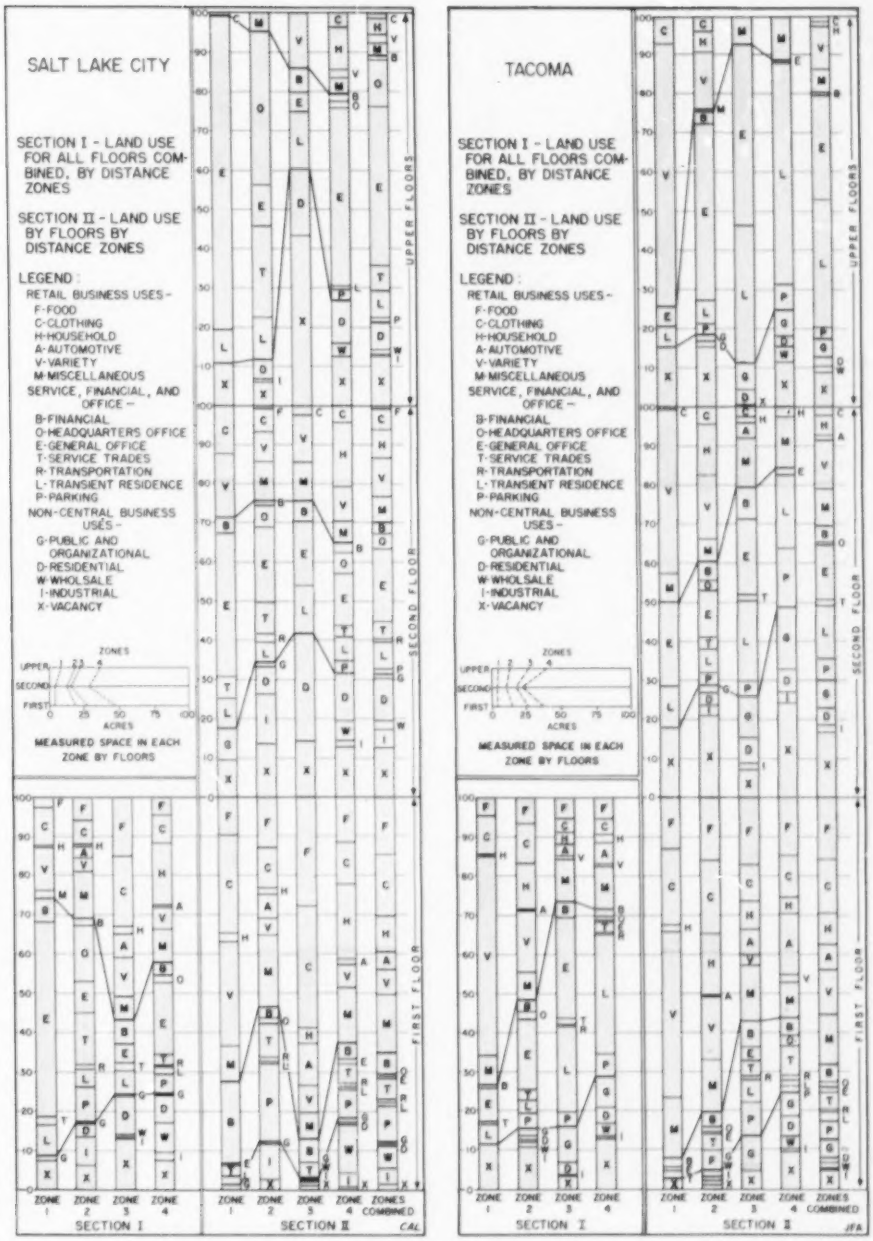


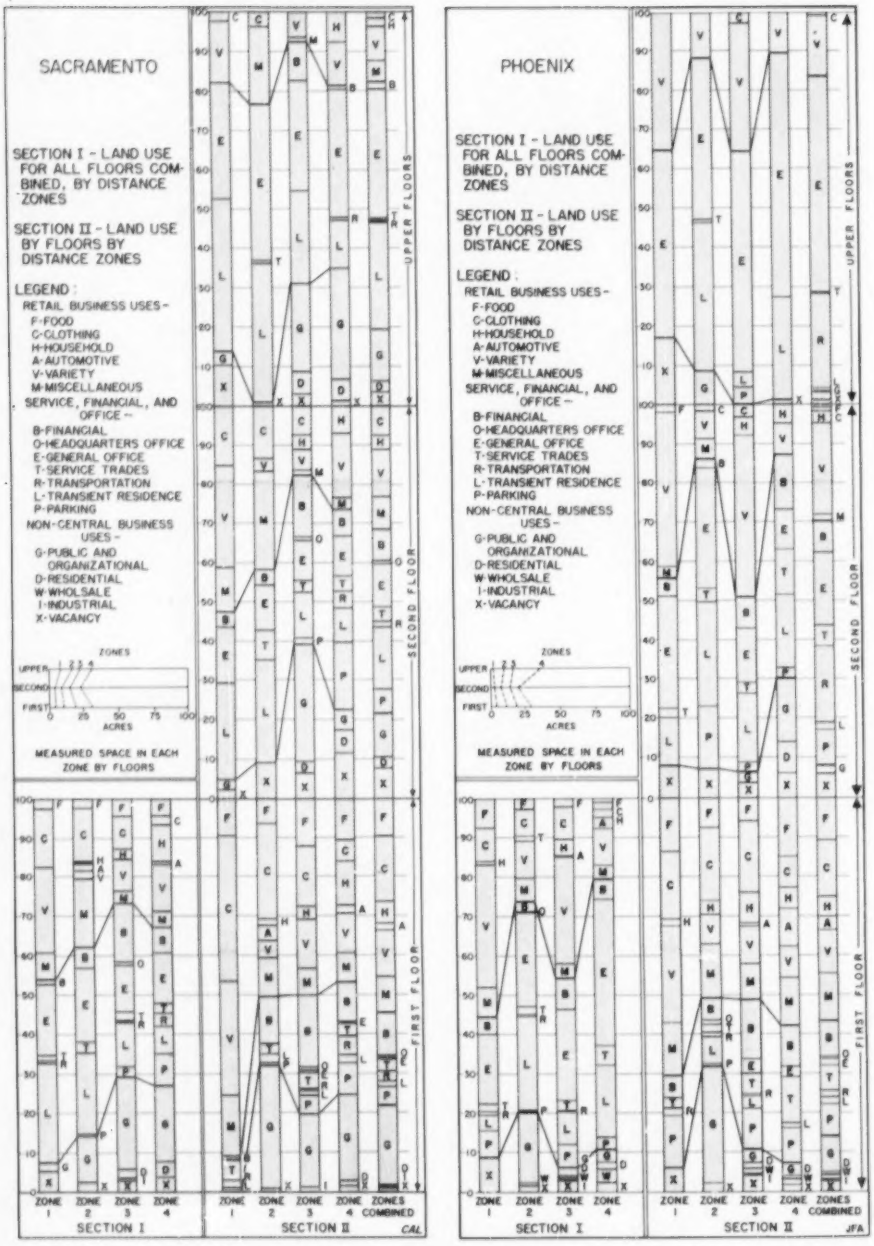
FIG. 3. Land use analysis by distance zones for an average of the eight CBDs.



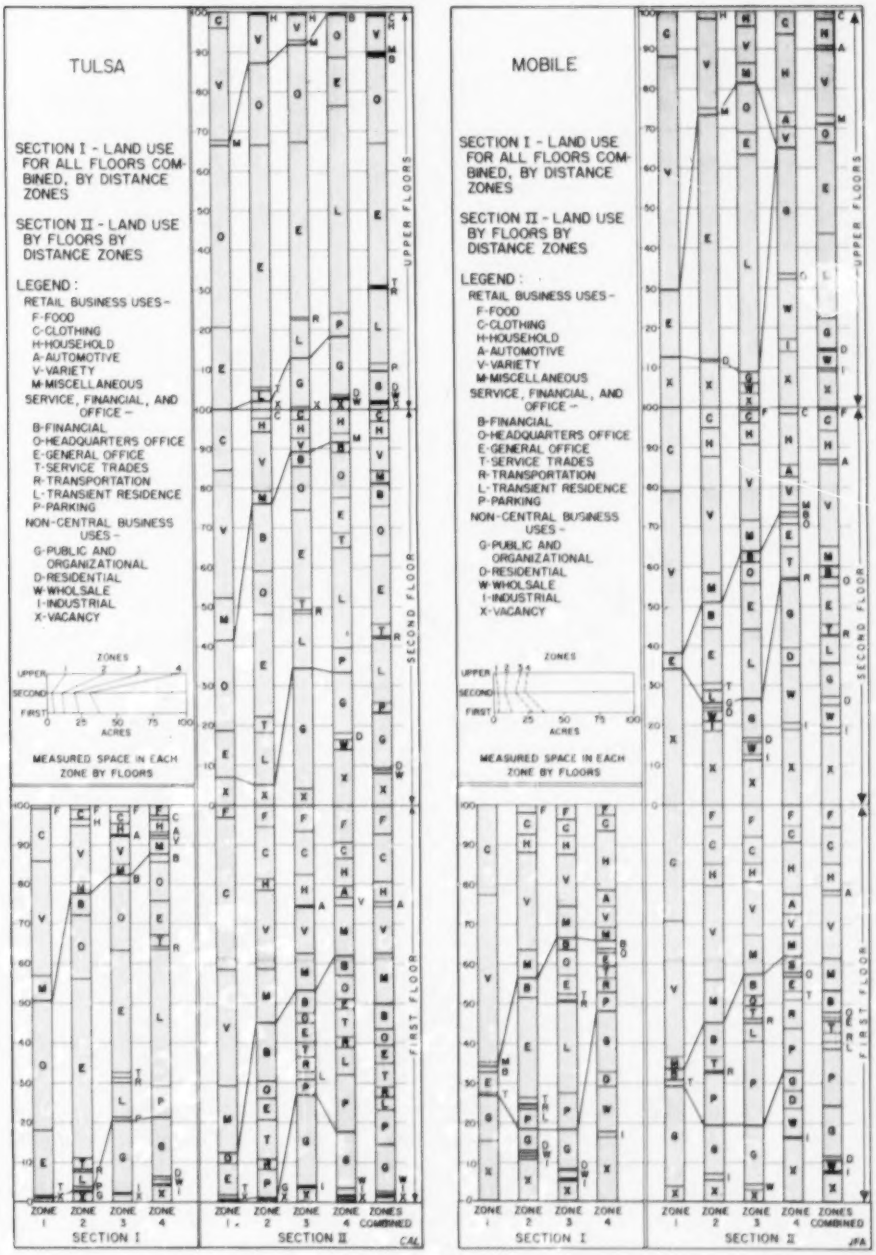
FIGS. 4 and 5. Land use analysis by distance zones for the Worcester and Grand Rapids CBDs.



FIGS. 6 and 7. Land use analysis by distance zones for the Salt Lake City and Tacoma CBDs.



FIGS. 8 and 9. Land use analysis by distance zones for the Sacramento and Phoenix CBDs.



FIGS. 10 and 11. Land use analysis by distance zones for the Tulsa and Mobile CBDs.

only 12 per cent of the total space. The great relative importance of retail business uses in the zone is to be expected, since the location gives access to the maximum number of customers. On the other hand non-central business uses by definition[8] do not belong in the CBD and certainly should be at a minimum in the heart of the District. It may be pointed out that these uses occupy much less space in the centers of CBDs of newer, Western cities, like Tulsa, Phoenix, Salt Lake City, and Sacramento, than they do in those of older, Eastern cities such as Worcester, Grand Rapids, and Mobile.

Among the use types into which the groups are subdivided in this study, variety stores (see footnote 4, p. 26) lead in the proportion of space occupied in Zone 1. They are followed by general offices and by clothing stores, both logical types of use for the central zone of a CBD. But, strangely enough, vacancy ranks next, largely because of its importance in the zone in Grand Rapids and Mobile. After vacancy in Zone 1 come transient residences (largely hotels), headquarters offices, and various lesser uses.

We have been considering thus far the ways in which the space in Zone 1 is used. Of more interest than mere proportional land use, however, is the question of relative concentration in this zone compared with the others. What uses are present in greater proportion than in the other three zones, and, conversely, what types of establishments are likely to be absent from or unimportant in Zone 1 but important elsewhere?

Focusing, again, on Section I, Figure 3, note that all space uses are shown in percentages. The same use, if of equal relative importance in all zones, would have exactly the same space allotment on the vertical bar for each zone. Obviously, this is not the case. But the spaces they do occupy on the different bars can be compared directly in order to see how the several zones vary in the relative importance of a certain land use type or group. A simple method of analysis is to rank the zones. For any land use, the zone with the greatest space on the chart allotted to that use ranks first; the zone with the next greatest space, second; etc. (Table III).

TABLE III

RELATIVE RANK-ORDER OF THE FOUR ZONES IN PROPORTION OF SPACE OCCUPIED BY VARIOUS TYPES OF ESTABLISHMENTS

(Compare with Section I, Fig. 3)

	Zones			
	1	*2*	*3*	*4*
RETAIL BUSINESS USES	1	2	3	4
Food	4	3	1	2
Clothing	1	2	3	4
Household	4	3	2	1
Automotive	n.r.	3	2	1
Variety	1	2	3	4
Miscellaneous	4	1	3	2
SERVICE-FINANCIAL-OFFICE USES	4	1	2	3
Financial	4	2	1	3
Headquarters Office	3[a]	2[a]	1	4
General Office	3	1	2	4
Service Trades	4	2	3	1
Transportation	4[a]	3[a]	2[a]	1[a]
Transient residence	4	2[a]	3	1[a]
Parking	4	2[a]	3[a]	1
NON-CENTRAL BUSINESS USES	4	3	2	1
Public and organizational	4	3	1[a]	2[a]
Residential	n.r.	3[a]	2[a]	1
Wholesale	n.r.	3	2	1
Industrial	n.r.	1	3	2
Vacancy	1	4	3	2

n.r. Not represented in zone.

[a] Approximately equal to others with similar superscripts in the same horizontal line.

To begin with, this is the zone that ranks first in the Retail Business uses group. Within the Retail Business group, Zone 1 ranks first in variety stores, which we found to be the leading space user in the zone. Apparently, variety stores have a tendency to be concentrated near the center of the CBD (Fig. 12). This tendency is

[8] Murphy and Vance: "Delimiting the CBD," *op. cit.*, p. 204.

FIG. 12. The black areas in this chart are variety stores and clothing stores. These two types are alike in extending closer to the peak land value intersection (the small circle on each map), than most other types of establishments. Based on ground floor use only.

emphasized by the steady zone-by-zone decline away from Zone 1. The concentration of department stores (the most important member of the variety type) near the central point of the District, where they will be accessible to the maximum number of customers, is traditional; and clothing stores are concentrated near the center for much the same reasons. No doubt, too, clothing stores are often located near department stores in order to share the customers

attracted by the larger stores. The whole matter of functional associations will be discussed in a later section of this paper.

Zone 1 ranks first in vacancy (Table III). At first glance this would appear to be an anomaly. Surely here, at the center of the CBD, space should be used to the utmost. But taxes and rents are high in this part of the District, so a slightly less central location often is preferred. Combined with this is the fact that some of the oldest and least desirable business buildings are found near the center of a city. But one must remember, too, that we are dealing with an average. Vacancy in the innermost zone is particularly striking in Grand Rapids, Mobile, and Tacoma, whereas very little was recorded for Zone 1 in Tulsa (Figs. 4–11).

It is of interest, too, to examine the reverse side of the coin. Which types of establishments seem to avoid Zone 1 as compared with the other zones? The Non-central Business group as a whole is at a minimum here (Fig. 3 and Table III), as is to be expected, since this is the heart of the District. No occurrences at all were recorded for residences, factories, or wholesale establishments. The reasons for their absence are too apparent to need amplification. Public and organizational land and establishments are better represented in the other zones, largely because most of the representatives of this group do not need great centrality. But here again the generalization due to averaging comes in. Public and organizational land use in the innermost zone is fairly important in Worcester, an old eastern city with a common and city hall. Even in Worcester, however, public and organizational land use is of greater relative importance in two of the other zones than in Zone 1. As pointed out earlier, vacancy, unlike the other Non-central Business uses, reaches its greatest relative importance in Zone 1.

The Service-Financial-Office group, too, is less well represented in Zone 1 than in the other zones. The service trades, transient residence (largely hotels) (Fig. 13), and parking are all less important than in Zones 2, 3, and 4. Most of the service trades (see footnotes 4, p. 26) do not yield great enough returns to pay the costs of a very central location; and hotels, which require considerable space for effective operation, are actually handicapped by the congested traffic close to the center. Parking presents somewhat of an anomaly: though in most cities it is relegated to the other zones or to the edges of the District, the demand for parking is greatest in Zone 1. Parking garages, with vertical extension, have been the answer in some cities. Phoenix is the only city of the eight under consideration in which parking in Zone 1 was proportionally greater than in any of the other zones. Still another member of the group, financial establishments (largely banks), in spite of the fact that they are generally thought of as being at the center of the city, are less important in Zone 1 than in the other zones (Fig. 14). Apparently, banks do not need the extreme centrality of the innermost zone to operate successfully.

Although the Retail Business group has its maximum relative importance in Zone 1, there are certain types of retail business establishments that are less important relatively than in the other zones. Automotive stores, for example, are not represented at all; and outlets for household goods are less well represented than in the other zones (Fig. 15). The type of business carried on by these stores does not justify the high costs of the central zone, and such stores are likely to have

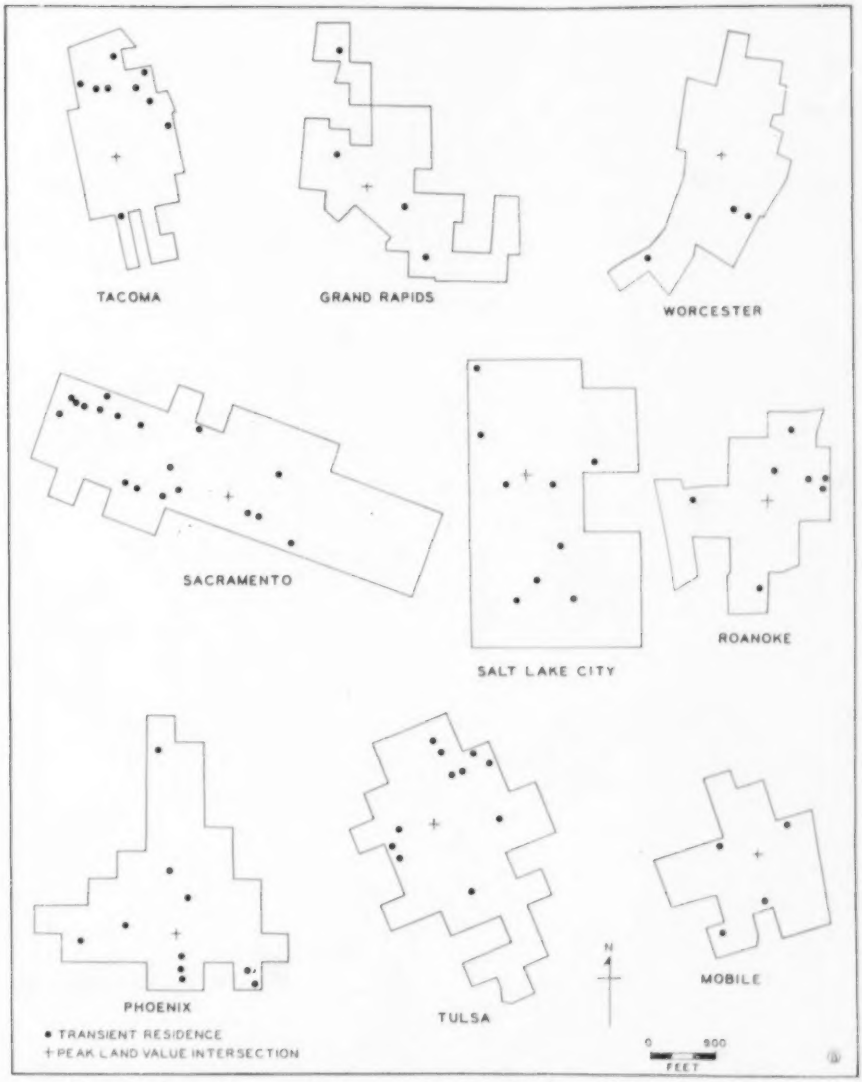


FIG. 13. Transient residences, which amount largely to hotels, avoid the peak value intersection. Each dot is located at the approximate center of an establishment.

large space needs, including the need for parking space. Food stores, too, are slightly less important, relatively, in the innermost zone than in any of the other zones. This probably is a reflection of the tendency to locate supermarkets near, or beyond the edge of, the District in order to avoid the crowded conditions and lack of parking space nearer the center.

The Gradation Outward.—With increasing distance outward from the 100-yard distance zone several changes take place. In the average for the eight

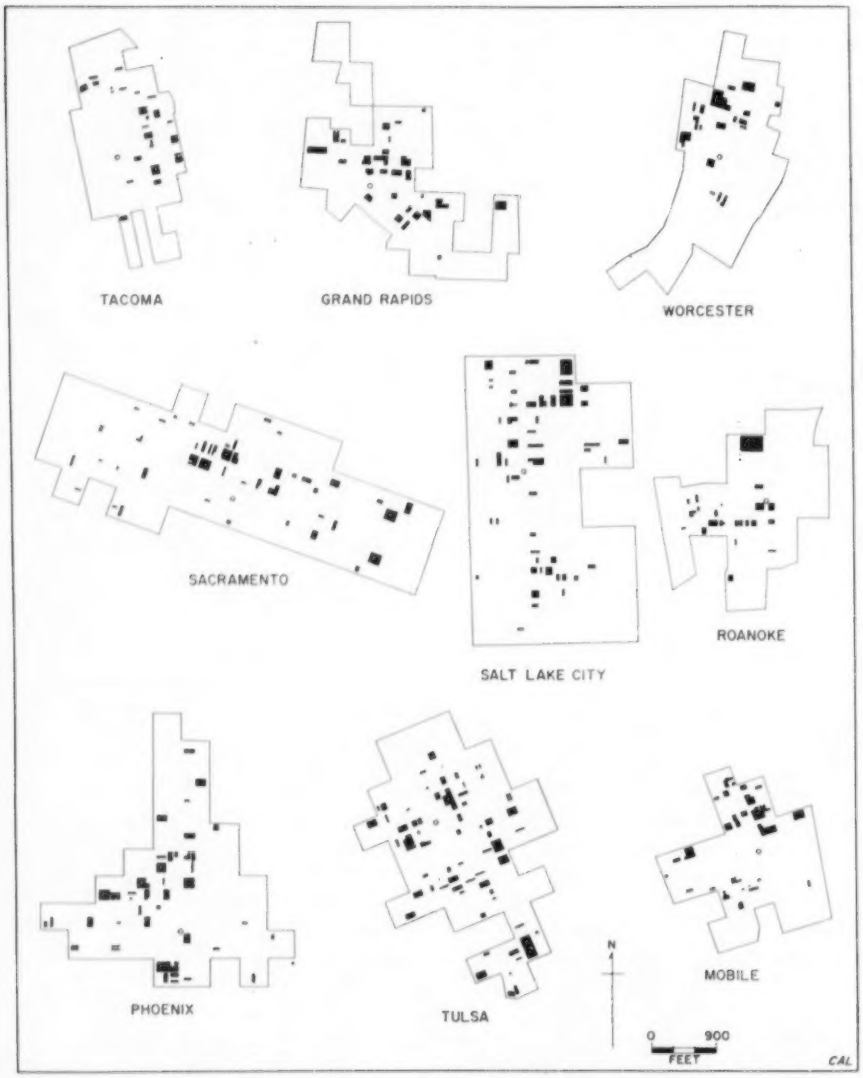


FIG. 14. Financial and office uses are here shown together. Note that they show no great tendency to concentrate close to the peak land value intersection, which is shown as a small circle on each map. It must be remembered, however, that this chart, like Figures 12, 13, and 15, is based on ground floor use only.

cities, Non-central Business uses increase from 12 per cent in the 100-yard zone to 23½ per cent of the space in the fourth zone, 300–400 yards from the peak land value intersection. The Service-Financial-Office group reaches a maximum in Zone 2 and then declines outward, but in Zone 4 it still occupies a substantially greater proportion of the land than in Zone 1. Retail Business

FIG. 15. Automotive establishments and stores specializing in household goods have certain common attributes and so are here shown together. Note that they do not, ordinarily, come very close to the peak land value intersection, the small circle on each CBD map.

uses, occupying 55½ per cent of the space in Zone 1, decline to 33 per cent in Zone 2 and then decline more gradually with increasing distance outward, occupying about 25 per cent of space in Zone 4.

Even within the individual use types that make up the major groups, there is a consistent, zone-by-zone change outward. For example, variety stores decline in relative importance from 35 per cent of the space in Zone 1 to

4½ per cent in Zone 4. Clothing stores exhibit a fairly steady decline outward. On the other hand, stores specializing in household goods, and automotive stores, show a consistent outward increase in relative importance (Table III).

However, other individual use types change less consistently. Outstanding in this category are general offices, which have their largest representation in Zone 2; headquarters offices, which are most important in Zone 3; transient residences, poorly represented in Zone 1 but fairly evenly represented in the other zones; financial establishments, with their highest proportion in Zone 3; public and organizational uses, reaching their maximum in Zone 3; and food stores, which, though tending in general to increase in importance with distance from the center, are slightly more important in Zone 3 than in Zone 4. Industrial land use, absent from Zone 1, reaches its maximum in Zone 2, but it is a very minor item even there.

In many ways the most interesting of the types mentioned in the last paragraph is the office class. Two kinds of offices are represented: general and headquarters. General offices are the greatest single space user in the CBD, though their importance is sometimes not fully realized since they occupy, for the most part, second and upper floors. As may be seen in Section I, Figure 3, general offices reach their greatest relative importance in Zone 2, but are important in all four zones. Apparently, being near the center is as desirable as being at the center for general offices, and being slightly removed even has certain advantages.

Headquarters offices represent a more specialized type of office use; generally they are the home or regional office of an oil company, insurance company, or the like. In Tulsa they are chiefly concentrated in Zone 1, but Tulsa is a very special type of city with an abnormally high development of the office function. In the average of the eight cities, headquarters offices, like general offices, are found in less central locations than Zone 1. Ordinarily, headquarters offices have less need for centrality than general offices. In some cities there is a tendency for the occupant of the headquarters office to build anew, farther out in the CBD or even outside the District altogether, leaving the original building to be rented to general office users.

The Fourth Hundred Yards.—The fourth hundred yards (Zone 4) is notable for its relative lack of Retail Business uses and for the importance of Non-central Business uses. These characteristics are normal end products of the progressive zone-by-zone changes referred to earlier.

The high rank of the zone in several of the individual use types is of particular interest. In spite of the low proportion of Retail Business uses, two members of the group, household sales and automotive sales establishments, have their highest proportional representation in this zone. So, too, do four members of the Service-Financial-Office group—service trades, transportation use, transient residences, and parking. Although the Non-central Business group as a whole reaches a maximum, only two of the types, residential and wholesale, attain their greatest relative importance in the zone. However, Zone 4 ranks second in public and organizational land use, in industrial land use, and in vacancy.

As in the case of the first 100-yard zone, it is of interest to see what types of establishments seem to avoid the zone. The relative unimportance of Retail Business uses in Zone 4 results from two outstanding members of the group, variety stores and clothing stores,

reaching a minimum in the zone. And two other use types, headquarters offices and general offices, occupy less of the space in Zone 4 than in any other.

Vertical Variations

In addition to the horizontal variations that have just been described, land use in the CBD varies vertically. The major elements of this vertical variation can be brought out by an analysis of the contrasts between the first, second, and upper floors.

All Zones by Floors.—First note the composite of all zones by floors (last vertical bar, Fig. 3, and Table IV). It is apparent that Retail Business uses predominate on the ground floor. The reason is obvious: this is the level most accessible to customers. It is common practice, of course, to use the ground floor of an office building for Retail Business enterprises. It may be seen from the graph and from Table IV that food, clothing, household, and automotive stores all reach their greatest relative importance as space users on the ground floor. So, too, does a miscellaneous group of retail businesses (see footnote 4, p. 26). The fact that variety stores are slightly more important, relatively, on the second floor does not mean, necessarily, that they occupy more space on the second floor than on the first. But most department stores are at least two stories in height, and, since total second floor area is less than total ground floor area, the relative importance of the variety store is greater on the second floor than on the first.[9]

Neither of the other major groups of establishments is as important in its proportional use of space on the first floor as on the second and upper floors, but several of the individual use types of these groups reach their greatest importance on the ground floor. Financial establishments, for example, are of greatest relative importance on the first floor, and the same is true of service trades and transportational uses. Parking is much more important relatively at ground floor level than at higher levels, and so are wholesaling and public and organizational land use, each of which reaches its maximum on the first floor. It might be thought that the demands for first floor space by Retail Business would relegate public and organizational land use almost entirely to upper floors, but parks and commons are included in the category and serve to augment its importance on the ground floor.

At the second-floor level, Non-central Business uses reach their greatest relative importance. Residential and industrial uses, though ordinarily not able to compete for ground floor space, enter,

[9] In this connection see "Measured Space in Each Zone by Floors," Figures 4–11.

TABLE IV

RELATIVE RANK-ORDER OF FIRST, SECOND, AND UPPER FLOORS IN ALL ZONES COMBINED IN PROPORTION OF SPACE OCCUPIED BY VARIOUS TYPES OF ESTABLISHMENTS

(Compare with last vertical bar, Section II, Fig. 3)

	Floors		
	First	*Second*	*Upper*
RETAIL BUSINESS USES	1	2	3
Food	1	2	n.r.
Clothing	1	2	3
Household	1	2	3
Automotive	1	3[a]	2[a]
Variety	2	1	3
Miscellaneous	1	2	3
SERVICE-FINASCIAL-OFFICE USES	3	2	1
Financial	1	2	3
Headquarters Office	3	2	1
General Office	3	2	1
Service Trades	1	2	3
Transportation	1	2	3
Transient residence	3	2	1
Parking	1	2	3
NON-CENTRAL BUSINESS USES	3	1	2
Public and organizational	1	2	3
Residential	3	1	2
Wholesale	1	2	3
Industrial	2	1	3
Vacancy	3	1	2

n.r. Not represented.

[a] Approximately equal to others with similar superscripts in the same horizontal line.

to a greater degree, on second floors; and vacancy is notably greater. It was pointed out in an earlier article of this series that office space on the second and third floors of old buildings, such as those that characterize several of the CBDs studied, is not in great demand.

For most types of uses the second floor is intermediate in rank-order between the first and upper floors. Thus, most Retail Business uses are present in smaller proportion on the second floor than on the ground floor level, but still are more important relatively than on upper floors. In office uses the second floor is again intermediate, but in a sequence in the opposite direction. The ground floor space is devoted to more intensive uses; whereas the upper floors are likely to be used for offices because these floors are not as desirable as the second floor for service trades, banks, and the like.

Among the general use groups, Service-Financial-Office uses dominate the upper floors, and Retail Business uses and Non-central Business uses, understandably, reach minima there. From the graph, as well as from Table IV, it is apparent that the upper floors are dominated by offices. Most tall buildings are office buildings in which all of the space at higher levels is devoted to offices. But transient residence is also important in the upper floors picture, and one Retail Business use, the variety store, is moderately well represented. The explanation for the significance of transient residence and variety store use is much the same as for the dominance of offices. Other than high office buildings, the tallest buildings of the CBD are likely to be hotels and department stores.

In the Non-central Business group, public and organizational land use is the principal type, chiefly represented by an occasional high public building or use of a suite of rooms by a lodge. Vacancy, though of greater relative importance than on the first floor, is not as important as on the second floor, since it is particularly in old, low (two-or three-story) buildings that floors above the first are in slight demand.

Vertical Variation by Zones.—Vertical variations by zones may form the basis for further differentiation in the land use picture. As can be seen from Figure 3, the proportion of space devoted to Retail Business uses decreases with distance from the peak land value intersection at all three levels. Non-central Business uses and Service-Financial-Office uses tend to increase in relative importance with distance outward. It is interesting that this progression of uses outward is the same whether all three levels are considered separately or as an average.

The horizontal and vertical variations that have been described are based on an average for the eight cities. The reader may wish to study the graphs of the individual CBDs (Figs. 4–11) to see how each differs from the average. The same methods of analysis can be applied to each of these graphs as were applied to the average of the eight.

Land Use Associations

Distance from the peak value intersection is not the only motivating force that helps to determine where a given type of land use will be found in the CBD. If it were, the typical CBD would consist of a series of concentric zones, each with unique uses. This, of course, is not the case. There is, among other things, a noticeable, rough clustering of establishments, mutually dependent upon one another. To some extent, of course, every enterprise in the CBD depends upon all of the others, for the whole assemblage

generates the mass of customers upon which the District depends.

The relationship between certain kinds of establishments, however, is often much more compelling than mere dependence upon the whole assemblage. There is, for example, the well-known tendency of department stores to locate near each other. And there are recognized associations of stores which seem to occur repeatedly. Each department store, for instance, is likely to have its coterie of smaller stores—clothing stores, drug stores, five-and-ten cent stores—located close at hand. Not only do these stores all seek the same type of location, near the heart of the District where the pedestrian count is high, but they all profit by being available to the customers attracted by the others and particularly by the large department store, which is in any case the dominant member of the group.

Other groupings can readily be picked out. Stores handling office supplies and furniture usually associate themselves with office buildings. Lawyers' offices, real estate offices, and bail bond agencies often form a group near the court house. Low-priced theaters are likely to be associated with kindred low-priced establishments such as pawn shops, cheap restaurants, and stores handling low-priced jewelry or clothing. Men's clothing stores of the better class may make either of two different types of affiliations. They may be found near the large department stores where they depend partly upon women shoppers who buy for the family; or they may be located near banks and office buildings where they depend in part upon the men who work in these places.

Clustering, of course, is not confined to the ground floor level. There is vertical clustering as well. This is particularly apparent in office buildings, where various kinds of offices seem to benefit from close association with one another. Lawyers, insurance brokers, and real estate agents frequently locate together. Physicians often profit from close association to the extent that whole sections of buildings may be devoted to their offices. The ultimate along this line, of course, is reached in the headquarters office building, where all but the ground floor may be devoted to the business offices of a single firm.

No attempt was made in this study to examine quantitatively this intriguing subject of land use associations. It has been studied by others.[10] But some of the more obvious clustering tendencies have been noted, enough to indicate that an appreciation of these associations is vital to an understanding of the details of CBD structure.

There is the further complicating factor that the associative tendencies themselves are constantly changing. Food stores, for instance, which used to be a typical land use associated with department stores and other stores patronized by women shoppers, have been moving from the CBD's center, leaving only a few food specialty shops (bakeries, delicatessens, poultry stores) as remnants of a once important land use type. A similar trend can be detected in some types of variety stores. In general, those types of retailing that depend upon frequent, day-to-day shopping seem prone to move out of the CBD, leaving at the city's center only those stores that depend upon infrequent or highly specialized sales.

DYNAMIC ASPECTS OF CBD STRUCTURE

It has been pointed out frequently in this series that the CBD of the American city is not static. Not only

[10] See, for example, Richard U. Ratcliff: "The Problem of Retail Site Selection," Michigan Business Studies, Vol. 9, No. 1, Ann Arbor, 1939.

are its outlines changing and difficult to define, its land use pattern vague and hard to describe, but also the CBD, itself, is highly mobile, in spite of the great investment in land and buildings it represents. The picture of the CBD, however sharp and accurate it may be, is no more than a glimpse of the moment. As such it reflects the past in the original site conditions and in changes through time; it reflects the present in its response to current economic conditions; and it carries a forecast of the future.

The minutia of changes going on in the average CBD are almost impossible to unravel, but there are broad elements that can be described, which help to rationalize the picture. For instance, it is a simple matter to recognize that the margins of the District are constantly fluctuating, advancing here and retreating there. It is also a matter of record that the peak value point of many CBDs has shifted from time to time in the past. It is our purpose here to examine these dynamic elements a little more thoroughly.

It has been assumed that a CBD tends to expand if the city is growing and to contract if the city is not growing. It is our belief that this is not the case. All the CBDs studied here show evidences of advancing along certain fronts and retreating along other fronts. Thus, there are "zones of assimilation" and "zones of discard." Figure 16 gives an approximate picture of the extent of these zones for each of the nine cities. What is the nature of these areas and where are they likely to occur?

Several authors have pointed out that the District tends to move toward areas of higher residential quality.[11] This process was observable in the nine cities studied here, but the reasons for the movement seem to be negative. It may be due not so much to the high-class residential area's attracting the CBD as to the fact that the industrial-wholesaling district near the railroads, with its attendant low-class housing, tends to repel the CBD. If movement takes place, it must occur at the expense of the better residential areas, areas that have, in fact, already begun to retrogress as the CBD's advancing shadow of blight falls over them.

It follows that the CBD will show differing land use characteristics in its zone of assimilation and in its zone of discard. In the zone of assimilation, specialty shops, automobile showrooms, drive-in banks, headquarters offices, professional offices, and the newer hotels are likely to be found. In the rear, on the other hand, in the zone of discard, one finds pawn shops, family clothing stores, bars, low-grade restaurants, bus stations, cheap movies; and credit jewelry, clothing, and furniture stores. These low-grade establishments depend in part upon the tendency toward clustering mentioned earlier, since they appeal to a similar economic level. And in the whole picture the factor of prestige enters. The van is the zone of the future, whereas the zone of discard lacks prestige and fosters commercial types that make no pretense to more than a place to sell goods and services.

As the CBD shifts, the peak value intersection is likely to move also. This is to be expected. We have already shown in Figure 2 that the peak value point is likely to follow closely behind the geographic center of the CBD, being only a few hundred feet away in most cases. If the whole area changes its position, the geographic center will

[11] See, for example, Robert E. Dickinson: "City Region and Regionalism," London, 1947, pp. 96-97.

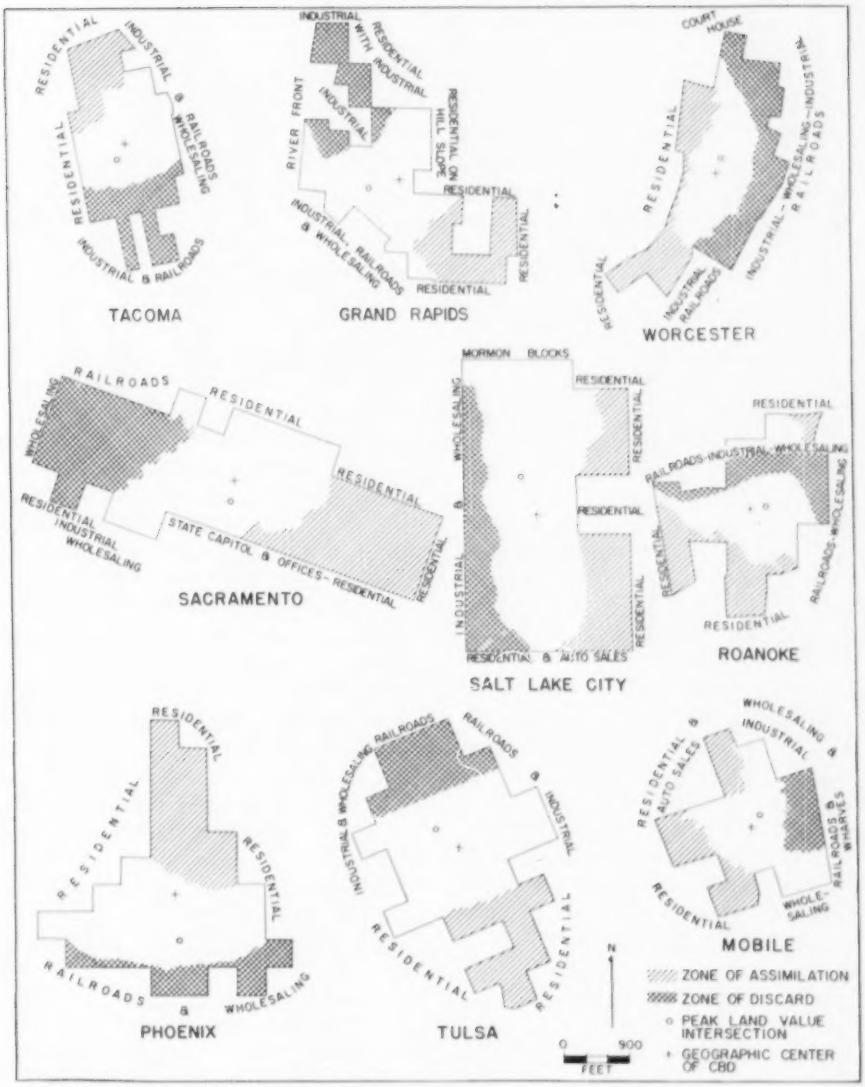


FIG. 16. Approximate positions of zone of assimilation and zone of discard in each of the nine CBDs. It may be assumed that the white areas are essentially static.

move, and so will the peak value intersection.

Let us look more closely at the manner in which the peak value point moves, and the underlying causes for its movement. At this critical intersection, where the land values are high and where there is a tremendous focusing of travel, large investments in the form of buildings are likely to be made. For this reason, as the District shifts its balance, causing a focus of travel else-

where, there is at first a great reluctance to abandon the investments around the original peak value intersection. The pull toward a newer site must build up slowly. Eventually, when the demand has become great enough, new buildings will be built at a new intersection and their very presence will help to make that location more attractive.

The movement of the peak value point, then, is not one of steady progress from one point to another, but rather one of leapfrogging, one or two blocks at a time. Few cities can boast that their present CBD's central zone, around the peak value intersection, is the same as the original center. Derelict centers are particularly characteristic of cities that began near a water front or near a railroad station. This whole subject of the movement of CBD centers and of the way the District, itself, shifts is an important one for further study.

A CBD Synthesis

Much that has been said in this and in previous articles of the series has amounted to analysis, a taking apart of the CBD. It is wise, however, to look at the District as a whole, as it appears in an average American city of moderate size.

The key point in any CBD is its peak land value intersection, never more than a few hundred feet from the geographic or areal center of the District. For those who do not know a particular city it may be hard to identify this peak value point, since land values cannot be observed directly and since the peak point is not, necessarily, in the immediate vicinity of the tallest buildings. But there are two telltales that indicate the presence of the peak intersection. It is the point where pedestrians are most numerous, and, in some cities at least, it is the intersection with maximum vehicular traffic.

With distance from the peak point, land uses vary considerably. In the inner zone around the peak point one is likely to find one or more department stores, with such closely related establishments as women's clothing stores, drug stores, five-and-ten cent stores, restaurants, and miscellaneous specialty stores of one kind or another. In a few cities, a city hall and a park or common may occur near the peak value intersection. But one thing is true of most stores in the inner zone: for their kind, they are likely to be large. Here one finds the District's largest department stores, the largest drug stores, the largest five-and-ten cent stores. Department stores frequently occupy several floors of a building, but most of the other retail users remain on the ground floor or at best make use also of a basement and the second floor.

Though substantial buildings often occur around the peak value intersection, a little farther from this point even taller buildings are likely to be found, with retailing occupying the ground floor and offices dominating the floors above. Some of the city's tallest buildings have been built to house the central or regional offices of single companies, in which case use may be uniform from top to bottom. More often, though, office buildings are characterized by a number of individual units, and frequently these individuals do a considerable amount of business with one another. Banks and hotels are likely to be located in the belt two or three hundred yards from the peak point. Hotels, in fact, are even more important at still greater distances from the center.

In cities of this size, it is unlikely that a definite hotel district, or theater district, or even a financial district will have developed. Cities of this population class are too small for such differentiation. But there is some tendency

for two or three department stores to cluster, or for several banks to do so. And there are definitely high-grade and low-grade sections of the District. Whole sections occur in which all the goods and services are characterized by a common, low price level. These are usually to be found in the zone of discard typical of all these cities. Here the spirit is very different from that in the section where new hotels, new stores, and elite dress shops occur, in the direction of the CBD's advance.

Typically, near the edge of the District such establishments as furniture stores and automotive stores occur, and, still farther out, often spilling over the edge, one finds auto sales (with associated garages, filling stations, and the like) and supermarkets, both land uses that require not only cheaper land but also much parking space. This area close to the edge of the CBD is, in a sense, automobile oriented, especially where it occurs near the ends of an elongated District.

It must be remembered that the edge of the District is always gradational. The gradation varies with the nature of adjacent areas. Along the edges of sections dominated by industry and wholesaling these activities as well as low-grade residences may extend into the District, often on the second and third floors of buildings whose ground floor levels are occupied by low-grade commercial establishments. Beyond the District's edge, of course, these land uses become more important than commercial activities, even at the ground level. Higher-quality sections of the CBD, on the other hand, tend to grade into strings of commercial development that extend into better-class residential areas. Here, too, upper floor residences may characterize the outer fringe of the District, but new apartment houses and better-class rooming houses are more likely to be found in these areas, along with new commercial development, whereas wholesaling and industry are not likely to be present at all.

CONCLUSIONS

In this article and in the two preceding ones of the series, a comparative method has been used in an attempt to learn more about the CBDs of American cities. These studies and others by urban geographers and workers in nearby fields are little more than a start toward building up a real knowledge of this important part of the city. Much more work must be done, both of a theoretical nature and in application of theory to practical problems.

The problems of the CBD are endemic to American cities, as well as to those of many other parts of the world. They are a product of our great emphasis upon urban life occurring simultaneously with the achievement of great mobility in transportation. Our cities seem literally to be flying apart. And yet, some sort of nucleus must be maintained, some center around which the disparate parts may congregate. Just what this center will be like when the period of readjustment is over is the all-important question. Much depends upon the answer. Billions of dollars are involved.

It is a problem that must be solved before really intelligent planning can proceed. Why attempt to arrest the flight of retailing activities to outlying shopping districts, if that is the long-time trend in any event? Perhaps the CBD of the future will be a Central Office District, an area in which the business enterprises of the city will maintain their offices, accompanied by only enough retailing to serve the immediate needs of the people who work in the office buildings. Perhaps, on

the other hand, there will be a way of expediting travel into and out of the CBD so that it may continue to be a retailing center as well as an office center. It may well be that retailing is doomed in the CBDs of very large cities, but that this function can be successfully maintained in the CBDs of moderate-sized cities. If this is true, we need to know the maximum size of city in which there is hope of maintaining the District's retailing function.

Certainly, with downtown crowding being so important in the flight of retailing to the suburbs, there is no excuse for Non-central Business uses of land being continued in the CBD. Manufacturing, wholesaling, warehousing, residences, and long-term vacancy have no place there. This precious land should be used as efficiently as possible for purposes that will intensify and stimulate greater prosperity in the District; all else should go.

Perhaps this ruthless pruning would have the desired effect. But in any case we need to know more about our CBDs, and we need to be able to apply our theoretical knowledge, when it has been acquired, to practical problems. Thus, in urban geography, as in other lines of research, theory and practicality go hand in hand, each modifying and affecting the other.

THE NEW IRRIGATION ERA IN IRAQ

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THE origin of irrigation in Mesopotamia is hidden in the dim, pre-Sumerian past, perhaps more than 6000 years ago. It is not necessary for our present purpose to trace historic advances and regressions in the irrigated area. It should, however, be realized that contemporary irrigation is partly based upon the system developed to its utmost ancient extent under Babylonian, Sassanian, and Abbasid rulers, which was ruined by the Mongol invaders, and left unrestored by the Ottoman Turks. More important, recently improved methods of constructing dams, controlling large rivers, distributing water to the land through canals, and drainage enable the Government of Iraq to devise plans which, when fully executed, will extend the cultivable land of the plains beyond its ancient limits, and will irrigate perennially where, in ancient times, only seasonal watering could be achieved.

Relief Features of the Mesopotamian Lowland

The plain of Mesopotamia (nowadays often called by its Arabic equivalent, Rafidain), is sometimes defined morphologically as the delta of the Tigris and Euphrates. It is true that the Euphrates at Hit and the Tigris at Samarrah leave valleys in which both are confined by bluffs to traverse lowlands across which they are free to meander and to bifurcate. In this respect, they may perhaps be compared with the Nile at Cairo. But the alluvial lowland of Rafidain is not a true delta of the classical, arcuate type (such as that of the Nile) nor a bird-foot delta (like that of the Mississippi). It is rather a complex lowland of accumulation in which several distinct units may be discerned, when the contoured maps (based upon the precise levelling carried out by the Survey Department of Iraq since 1920) are examined (Fig. 1).

A large part of the lowland has been deposited by tributaries, and not by the main rivers. Thus, on the left bank of the Tigris, the Diyalah, after debouching from the foothills, flows across a well-defined piedmont alluvial fan, which has tended to extend southwards rather than southwestwards. This fan is confluent with that of the river Adhaim, a smaller tributary flowing along a parallel course to the north. Nearer the sea, the Karun has deposited a similar and somewhat larger fan, extending from the foothills almost to the Shatt-al-Arab. The Euphrates receives no perennial right-bank tributaries; but the wadis from the Syrian Desert have brought a considerable accession of alluvium to the lowlands, and in so doing have influenced the courses of the main rivers. In the latitude of Baghdad, the Diyalah has thrust the Tigris westwards, whilst the two large wadis Ghadaf and Ubaiyidh have diverted the Euphrates eastwards.

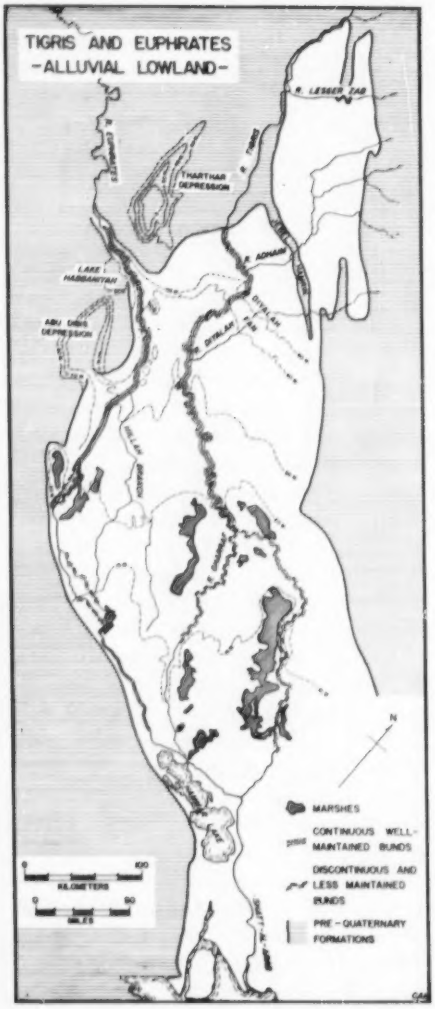

FIG. 1. The alluvial lowland of the Tigris and Euphrates. (Geological boundary from L. Dubertret, "Carte Geologique du Moyen-Orient." Contours derived from the relief model in the Irrigation Department, Baghdad, by J. S. Turcan. Data concerning embankments from A. Sousa, "Iraq Irrigation Handbook," Vol. 1 [maps], and "Haigh Commission Report.")

Here the two main rivers are but 30 miles apart, a fact that has contributed to the importance of Babylon (near the present Hillah) and Baghdad.[1] To the south, the Tigris and Euphrates have both thrown off distributaries beginning at Hindiyah on the Euphrates and Kut on the Tigris, and both overflow widely during the flood season. Nearer the sea, a single channel, between the foot of the Karun fan and the edge of the Arabian plateau, conveys the small remnant of the combined discharge to the sea. Thus there is no true delta at all, for the tides at the head of the Persian Gulf not only assist the Port engineers at Basra to maintain a navigable channel for large ships, but enable date groves to be irrigated twice daily without recourse to pumping.[2]

It should be observed that the alluvial lowland proper of the Tigris, lower Diyalah, and lower Adhaim is bordered to the northeast by the Jebel Hamrin. This is a low range of hills, composed of lower Fars rocks (Miocene), and folded anticlinally. This series consists of marls and clays intercalated with layers of weak sandstones and gypsum beds. All three rivers have cut gorges through this ridge, and sites for barrages or dams thus exist which may be compared with that of the Lloyd (Sukkur) Barrage on the Lower Indus in Sind. Northwards of the Jebel Hamrin is another alluvial plain, partly loess-covered, which has been deposited by the middle Adhaim and the lower Lesser Zab above its confluence with the Tigris. This, like the main lowland of accumulation southwards of the Jebel Hamrin, was irrigated in ancient times and is partly irrigated today. In the present schemes for extension, it

[1] Most of the accumulation by the wadis tributary to the Euphrates, as well as by the Diyalah and Karun, was Pleistocene rather than Recent.

[2] Some features near the Persian Gulf are to be attributed to the fact that the plain has been formed in a geosyncline which is still active. See G. M. Lees and N. L. Falcon, *Geogr. Journ.*, Vol. 118, 1952, pp. 24–39.

is treated integrally with the main lowland.

THE RIVERS AND THEIR REGIMES

From Samarrah as far as Kut, the Tigris meanders in a single channel, confined by natural levees which have long been strengthened artificially in the interests both of flood protection and navigation. The present course, apart from changes in the form of meanders, has been maintained for centuries. Precise levelling reveals that the bed of the river has been raised above the land on either hand, and from the base of the levees there is in general a gentle slope for some distance away from the river. This facilitates irrigation by pumping of a zone extending

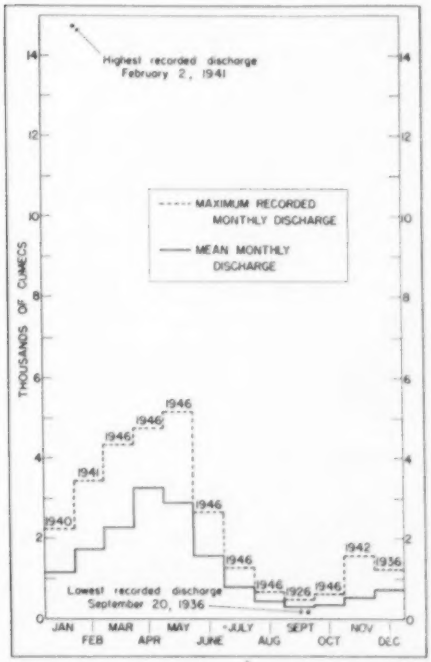

FIG. 2. The regime of the Tigris. (Data from the "Haigh Commission Report." The continuous line represents the mean monthly discharge; the broken line, the maximum recorded monthly discharge, with the year of occurrence.)

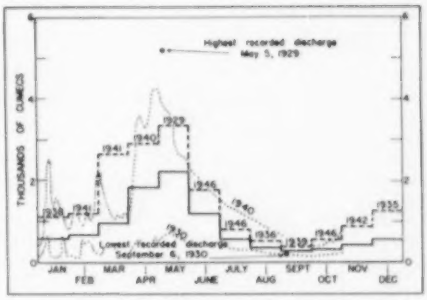

FIG. 3. The regime of the Euphrates. (Data and conventions as for Fig. 2. The dotted lines show the discharge plotted by five-day means during a year of low flood, 1930, and one of high flood, 1940, the data being taken from A. Sousa's "Iraq Irrigation Handbook," Vol. I.)

along both banks, and drainage by conducing to the flow of water across the land. Nevertheless, the Tigris in this latitude is at a lower altitude than the Euphrates, and from at least Babylonian times, the area between the two rivers has been irrigated by left-bank canals fed from the Euphrates.[3] Tigris water, in the past, was also diverted to the left of its course, particularly by the Nahrawan Canal, which, issuing from the Tigris near Balad and adding to its volume by a diversion from the Diyalah, irrigated a great tract of land almost as far as Kut. The restoration of this system is a principal objective of plans now being undertaken by the Development Board in Iraq.

In regime, the Tigris and Euphrates are similar (Figs. 2 and 3). The Tigris has the larger mean flow (1339 cumecs, i.e., cubic meters per second); and its highest recorded discharge has been estimated to have attained not less than

[3] Before these artificial works were constructed, the Euphrates, when in flood, discharged its waters into channels which were directed southeastwards. The Saklawiyah canal was constructed in 1919 along the course of one such channel; and the ancient inundation canals across this part of the plain may in general be regarded as a method of controlling part of the Euphrates flood and utilizing the water for irrigation.

14,000 cumecs at the Diyalah confluence. (This was probably exceeded during the disastrous flood of March, 1954.) The Euphrates is smaller. Its mean discharge at Hit is 837 cumecs, and its maximum recorded discharge 5200 cumecs. The Tigris has a smaller catchment area; but a larger area in which winter rainfall exceeding 20 inches is received. Much of this falls as snow, on land above 2500 feet, and the rivers rise rapidly in April after a winter in which normal or heavier-than-normal precipitation has fallen. But even in the mountains, the fall is apt to be deficient, so that often the spring rise is quite restricted. Although high floods usually occur in April or May, when the mountain snows are melting quickly, heavy rainfall throughout the basins may cause the rivers to rise very rapidly to dangerous levels in February. Floods are thus erratic and at times catastrophic. The most frequent floods (April–May) arrive at the time when winter crops are being harvested, and before summer crops can sprout. The very low level of water in late summer (August and September being the months of minimum flow) renders summer irrigation difficult unless water is stored and the level is raised by means of barrages. Since more water is generally available from November onwards (when the winter rains begin in the mountains), winter cultivation predominates. Only the few canals commanded by the Hindiyah and Kut barrages can at present be regarded as perennial; the others are essentially inundation canals, which often fail to command the land on either hand in summer.

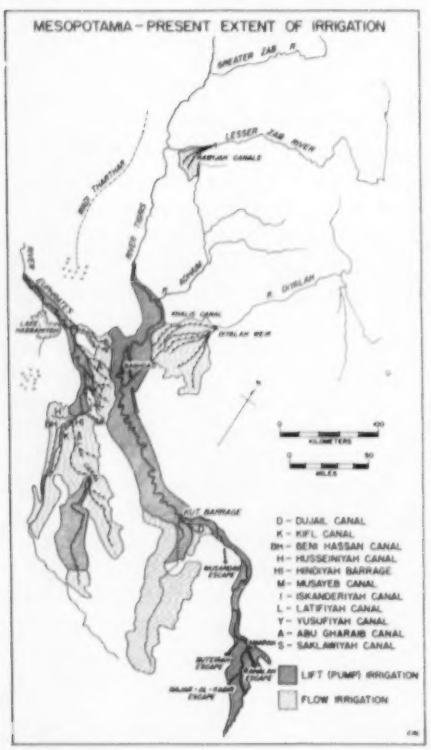

FIG. 4. The present extent of irrigation. (Data from the "Haigh Commission Report" and A. Sousa's "Iraq Irrigation Handbook," Vol. 1.)

EVOLUTION OF IRRIGATION

Neither ancient nor contemporary irrigation systems were planned to control floods or store water. Irrigation has made use of water at levels somewhat, but not much, above minimum flow. Thus the area watered has been restricted; and high floods have passed onwards to the sea; or have overflowed the plain. At the present time, most cultivated land is protected by the method of controlled breaching, i.e., when in flood, embankments are deliberately breached at points where the excess water will flow over uninhabited land. The safety of Baghdad, during the highest floods, can only be assured by breaching the embankments on the left bank above the city. The flood waters then pass at the foot of the Diyalah fan, along the course shown

by an arrow in Fig. 4 to join those of the Diyalah. The city is protected on the east by a ring bund, constructed between 1917 and 1919 by the British Expeditionary Force in Mesopotamia. When, from the Eastern bund, a waste of flooded land is visible to the east, the site of the city becomes an artificial island, encircled by the earthen walls which alone prevent its whole area from inundation to a depth of from 10 to 15 feet.

The present year (1952) is most appropriate for the purpose of reviewing the past and the future of irrigation in Iraq. For the Habbaniyah depression, which in the past has been used solely to receive Euphrates floods when the Hindiyah barrage was endangered, has now been converted into a reservoir from which, when needed, stored flood water can be conveyed to cultivable land. This is but the prelude to much greater works, already begun, which will enable river discharge to be completely controlled and will preserve nearly all flood waters for cultivation (Fig. 5).

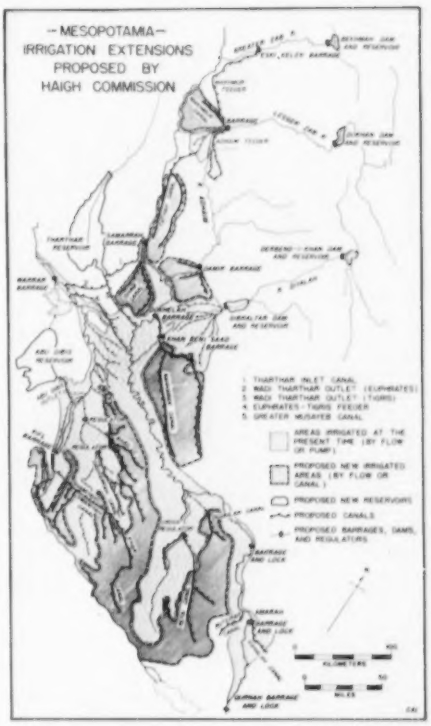

FIG. 5. Proposed extensions to irrigation in Mesopotamia. (Data from the "Haigh Commission Report.")

But it is first necessary to review the development of irrigation in the past. There is no doubt that ancient irrigation works could have been restored after the Mongolian inroads. That the Ottoman Turks failed to undertake this task was due to the character of Mesopotamia as a group of border provinces, remote from the capital and indeed, under Mameluke rule, quasi-independent: which also, several times, was a battle ground between the Imperial Power and Persia. But from time to time, particularly during the nineteenth century, when (after the restoration of Imperial control in 1831) a more vigorous hand was applied to government, restoration of irrigation was attempted, and nomads were settled on lands which for centuries before had been uncultivated. Thus, under the Mameluke Suleiman, the "Great Pasha," who ruled in Baghdad from 1780 till 1802, the Hindiyah canal was constructed to convey water to An Najaf and to water land on the right bank of the Euphrates as far as that city of pilgrimage. Under the vigorous Midhat Pasha (1868–71), nomads were settled on lands near Hillah, to which water was led in cleared ancient inundation canals.

Till the last decade, in fact, the slow revival of irrigation in Mesopotamia has been achieved principally by the restoration of ancient works. The Irrigation Department of Iraq, founded under the military government (1917–19) which preceded the Mandate, has

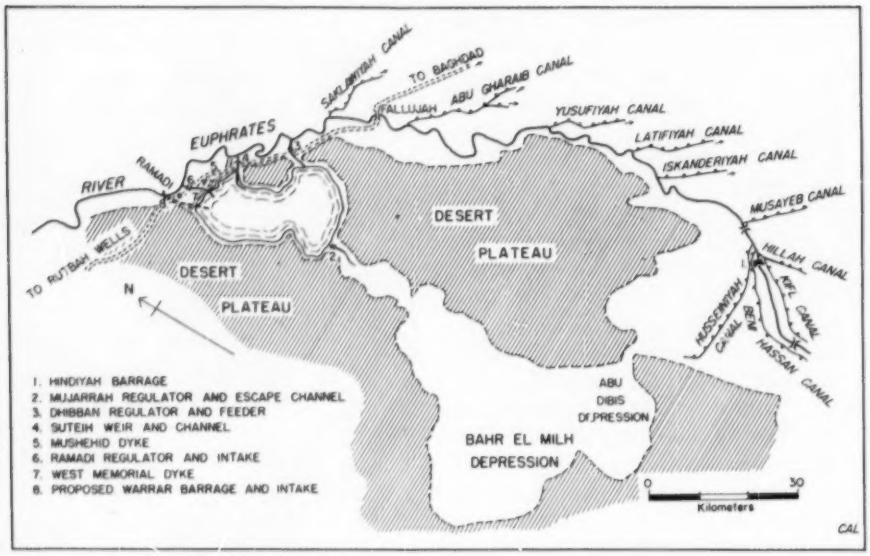

FIG. 6. Lake Habbaniyah and the adjacent reach of the Euphrates. (Data from A. Sousa's "Iraq Irrigation Handbook," Vol. 1, and "Haigh Commission Report.")

steadfastly applied itself to piecemeal extension and improvement of ancient canals, regulators, and weirs. By dredging and the construction of regulators, considerable tracts along the left bank of the middle Euphrates have been provided with perennial or semi-perennial irrigation, in place of rather limited and precarious watering from inundation canals. The cumulative effects of small works carried out year by year have considerably increased the efficacy of irrigation and in addition, gauging upstream has enabled the heights of the rivers during floods to be forecasted and the levees to be breached at the right time. Accompanying these works, and again on a small scale, but nevertheless cumulatively effecting considerable extension of the irrigated area, the diesel-engined pump has replaced the *shaduf* or the old-fashioned water wheel, so often described by travellers in Mesopotamia during the past two centuries. Many hundreds of such pumps have been installed along both banks of the Tigris and Euphrates, as well as at suitable places along inundation canals. A broad ribbon of land is thus perennially commanded along both banks of the Tigris and Euphrates (Fig. 4).

But larger works are needed to extend irrigation widely over the lowlands. Moreover, flood control and water storage must be combined with works designed solely to extend the benefits of perennial, or, to use the term employed in Iraq, flow irrigation. Only one such larger work was initiated by the Turkish regime, which did not function successfully before the outbreak of the First World War. This, the Hindiyah Barrage, was constructed by French engineers in 1891 to maintain the water level in the Hillah branch of the Euphrates.[4] This work, built of

[4] Since about 1800 water had been avoiding this channel to flow in greater volume along a distributary to the west, now generally regarded as the Euphrates proper. Before 1800, most of the discharge flowed naturally into the Hillah branch.

brick and provided with a central notch, collapsed in 1903. Under Sir William Willcocks, a second barrage was built between 1911 and 1914. This was damaged during the First World War, partly by the river itself, partly by faulty management, and partly by military operations. Restoration was completed in 1925; and its continuous functioning since that date has enabled the area of flow irrigation commanded by the Hillah branch to be considerably extended. Also, for about 55 km. upstream, higher water levels when the barrage gates are closed has improved the operation of several old inundation canals and has permitted new canals to be constructed.

The canals issuing upstream from the Hindiyah Barrage are thus divisible into three groups: (1) Those immediately upstream, to which the ingress of water is controlled by the Barrage and by regulators. These number four, *viz.*, the Hillah branch and the Kifl canal (on the left bank), the Beni Hassan and Husseiniyah canals (on the right bank). These are perennial canals, and are collectively known as the Hindiyah Barrage Canals (Fig. 4). (2) Those farther upstream, but within the reach (55 km. long) in which the water level is controlled by the Barrage. These canals are three in number, and all issue from the left bank. They are called the Musayeb, Nasiriyah, and Iskanderiyah canals. They may be regarded as semi-perennial. A limited amount of water can be admitted in summer, but less than the amount required for the complete irrigation of all the land commanded. In winter, the higher level in the Euphrates permits their full use. (3) The four canals issuing from the left bank, upstream of the reach influenced by the Hindiyah Barrage. These, from south to north, are the Latifiyah, Yusufiyah, Abu Gharaib, and Saklawiyah canals. These are inundation canals. All the water required for the commanded land can usually be admitted in winter, but in summer the Euphrates is too low, and the acreage of summer crops is restricted, despite the use of diesel-engined pumps.

In the past 60 years, the Euphrates has thus been utilized to a greater relative extent than the Tigris. Despite the greater discharge of the latter river, the amount of irrigated land is about the same in each basin, and in fact much of the irrigated land in the Tigris basin is watered from tributaries and not the main stream. Along the Euphrates the risk of serious damage to regulators and canals from high floods is less than in areas which could be irrigated from the Tigris, partly because the Euphrates (as already shown) does not rise to such extreme heights as the Tigris, and partly because a natural depression—Lake Habbaniyah—is available, into which dangerously high floods may be diverted above the reach from which the Middle Euphrates canals are derived. Indeed, apart from the levees, the river would discharge naturally into Lake Habbaniyah via the Suteih depression (except in years of low flood), and in years of exceptionally high flood would overflow via the Mujarrah channel into the Bahr el Milh and Abu Dibis depressions near Karbalah. To protect the irrigated land immediately to the south, breaching sections have been maintained in the western embankment at Suteih since 1920, and flood waters were permitted to pass into the lake on seven occasions between 1926 and 1941, *viz.*, 1926, 1928, 1929, 1938, 1940, and 1941. In 1942 a weir was constructed which permits the river to overflow into the lake whenever a predetermined level is attained; and the necessity to breach

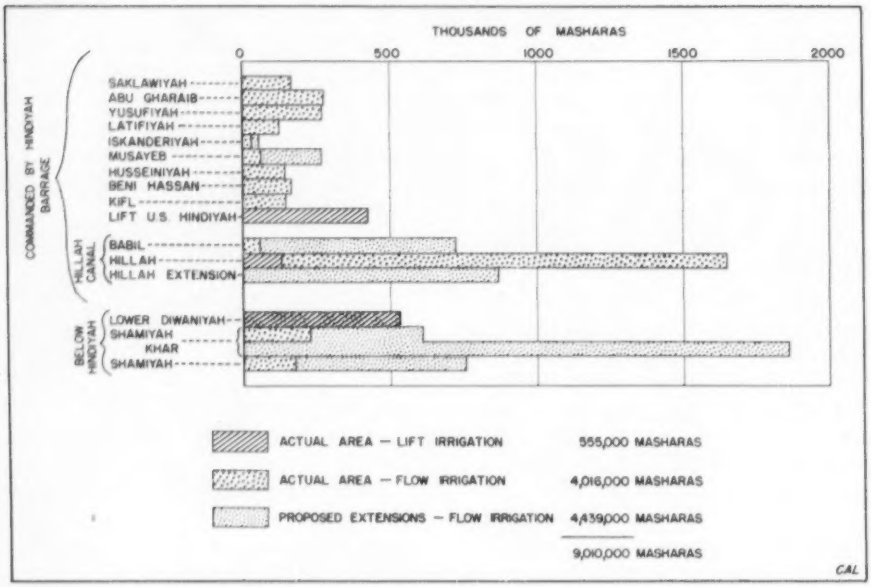

FIG. 7. Present and projected extent of irrigated land watered from the Euphrates. (Data from "Haigh Commission Report.")

the embankments thus is obviated (Fig. 6).

Moreover, in the past 13 years works have been constructed to convert Lake Habbaniyah into a storage reservoir. The Mujarrah channel has been provided with a regulator to retain flood water in the lake to a predetermined level. Dikes have been constructed at three places in the Suteih depression to prevent water issuing from the lake across the main road to Ramadi. A new inlet channel with a regulator has been cut at Ramadi (completed in 1952); and a new outlet channel with a regulator has been built at Dhibban (completed in 1950). Flood water is now admitted at Ramadi to a level controlled at Mujarrah, and any excess is permitted to flow into the Abu Dibis depression. Stored water is allowed to return to the river at the required rate via the Dhibban outlet (Fig. 6).

By contrast, the Tigris has been relatively neglected; and the zone of potentially irrigable land along its left bank is largely a waste. This is due to the greater volume of the Tigris high floods, and the absence of a convenient natural receptacle for excess discharge such as is provided for the Euphrates by Lake Habbaniyah. The arrangements for assuring the safety of Baghdad, already described, have also contributed to debar development in this area. Above Kut, in fact, apart from the zone commanded by pumps, the chief irrigated areas in the Tigris basin are watered by tributaries, chiefly the Diyalah. The large alluvial fan crossed by this stream after its passage through the Jebel Hamrin is a terrain admirably suited to irrigation, for distribution canals diverging from the defile can readily command separate sectors of the fan. Before 1918, temporary weirs were thrown across the Diyalah at the Jebel Hamrin, to raise

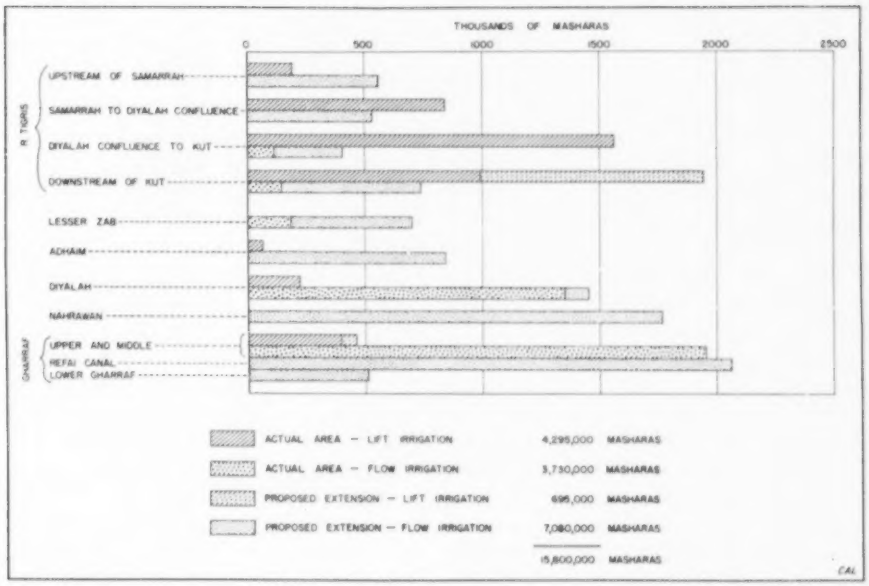

FIG. 8. Present and projected extent of irrigated land watered from the Tigris. (Data from the "Haigh Commission Report.")

the water level during the winter. These works were swept away by each spring flood. Very early in the Mandate period, a permanent weir (the Diyalah weir) was built to obviate annual rebuilding. Thus a supply of winter water is assured to the Khalis Canals and the Diyalah Canals; but this is insufficient for the perennial irrigation of the commanded land. In particular, summer crops are severely restricted.

The problem of flood protection and storage in the Tigris valley has been discussed by irrigation engineers for forty years. At the time he designed the Hindiyah Barrage, Sir William Willcocks was requested by the Turkish Government to make a survey of irrigation problems in Mesopotamia. His report, "The Irrigation of Mesopotamia" (1917) has been accepted as fundamental by all investigators since his day.

"The Willcocks report recommended the use of the Habbaniyah and Abu Dibis depressions for flood control and storage on the Euphrates, and proposed the construction of a canal to connect them which has since been constructed as the Mujarrah escape. For the Tigris he recommended what he realized to be a makeshift arrangement; the protection of the right bank by flood embankments and of Baghdad by a ring bund, allowing the flood waters to escape on the left bank. This system has been virtually followed to date. He saw the possibility of the Wadi Tharthar as a flood escape though he was unable to investigate it fully. Not knowing its capacity, and fearing it might prove inadequate, he considered carrying the escape across to the Euphrates and making use of the Habbaniyah and Abu Dibis depressions for the flood control of both rivers. Such an extension would also permit the use of the Wadi Tharthar for storage. Willcocks proposed the construction of four irrigation systems, to be commanded by four barrages on the main rivers: at Fallujah and Hindiyah on the Euphrates, and at Balad and Kut on the Tigris. Of these the Hindiyah and Kut barrages have been constructed and the left bank Euphrates canals built. . . ."[5]

[5] Report on the Control of the Rivers of Iraq and the Utilization of their Waters, by the Irrigation Development Commission, Baghdad, 1951, pp. 5–6.

It may seem that it is a long time since Willcocks surveyed these problems. Of his recommendations, only two major works have been completed, *viz.*, the Hindiyah Barrage and the Kut Barrage (1938–42). But, as has already been shown, lesser works have effectively augmented the area of commanded land from the Euphrates and the Tigris tributaries. Moreover, the thin population and the lack even of the basis of land registration and taxation, namely, cadastral surveys, caused the rate of planning to be slow. Disturbances during the establishment of the Mandate and agitation afterwards for the transference of power to Iraqis, followed, after the country became independent in 1932, by internal instability and by suspicion of foreign borrowing to finance capital works, contributed to the delay in beginning comprehensive works. Data, too, accumulated but slowly; and gauges at essential places on the main rivers and tributaries were not installed and calibrated until after 1930. By the late 'thirties, however, political and technical conditions warranted a further advance, and consulting engineers were invited to present a report, which was ready in 1940. Messrs. Coode, Wilson, Mitchell, and Vaughan Lee shared Willcocks' doubts about the usefulness of the Tharthar depression, and advocated that a dam or dams should be built in the mountains across the Tigris tributaries to form reservoirs in which flood waters could be stored. The first and largest of these reservoirs would be sited on the Greater Zab at Bekhmah. The Second World War prevented these plans from being executed.

CURRENT PLANNING

After the War, it was decided that a fresh investigation should be undertaken. An Irrigation Development Commission was formed, with Mr. F. F. Haigh as President. During three and a half years, from February 1946 to June 1949, this Commission was at work. Its lengthy report was published towards the end of 1951. During these years, it was evident that Iraq was entering a new era, during which rapidly increasing oil revenues could finance large capital works, without having recourse to foreign loans. A Development Board has accordingly been constituted to invest oil revenues, and has already sanctioned the construction of several important units in the Irrigation Development Commission's recommendations. The works intended to be begun in the first five years are summarized in Table I. Figures 5, 7, and 8 show the extensions to be effected in the irrigated area, on a map and by means of two diagrams. It may be remarked that the new schemes combine the recommendations both of Willcocks and the consultants reporting in 1940. The Tharthar depression is to be utilized, and dams are to be constructed on each of the major Tigris tributaries.

These works will extend over decades. Storage and flood-control works evidently must be given priority, for until dams are built and water begins to be stored, it is neither safe nor useful to construct canals to distribute water. Moreover, the capacity of the Tharthar reservoir cannot be estimated with accuracy. Percolation and evaporation will certainly be large. Furthermore, although the Dokhan dam, on the Lesser Zab is about to be built, geological exploration of proposed sites of other dams has not been completed. Thus the total storage capacity within the Tigris basin cannot be computed, and plans for distribution cannot proceed beyond a preliminary stage.

It may be added that the latest reviews of expert opinion given to the

TABLE I

WORKS SANCTIONED BY THE DEVELOPMENT BOARD FOR THE PERIOD 1951–1956

Name of Project	*Purpose*	*Additional Area to be Commanded (masharas)*	*Cost*	*Schedule*
I EUPHRATES				
Habbaniyah Stage 1	Regulators and canals to control entry and outflow from Habbaniyah Lake	2.8M	ID 2.7M	Completed 1951
Habbaniyah Stage 2	Increase of storage by barrage at Warrar and alterations to canals and regulators	1.2M	ID 1.6M	1952–1954 (tenders asked for)
Shatt-al-Hillah extensions	New and remodelled canals and regulators	4.0M	ID 2.5M	1951–1955
II TIGRIS				
(A) MAIN RIVER				
Wadi Tharthar Stage 1	Barrage at Samarrah; canal to Tharthar depression to reduce Tigris floods	.....	ID 9.6M	1951–1955 (works just beginning)
Regulators on Amarah	Control of Irrigation below Kut	0.28M	ID 1.2M	1953–1955
Regulators at Gharraf	Improved distribution of water commanded by Kut barrage	2.7M	ID 0.45M	1951–1955
(B) LESSER ZAB				
Dokhan Dam	Storage and power	.....	ID 2.3M	1951–1955 (works starting)
Hawijah Barrage	Command of Hawijah and new canals with feeder to Adhaim	0.12M	ID 0.5M	1953–1955
(C) ADHAIM				
Adhaim Barrage	To irrigate Adhaim fan	0.84M	ID 0.3M	1952–1953 (geological exploration of site in progress)
(D) DIYALAH				
Derben-i-Khan Dam	Storage and power	.....	ID 4.8M	(site studies in progress)
Khan Beni Saad Regulator	To command Nahrawan Canal	.....	ID 0.75M	.....
Nahrawan Canal	To distribute Tigris and Diyalah water	1.765M	ID 2.0M	.....

author confirm that the Tharthar depression is unlikely to prove the analogue of Lake Habbaniyah. It would require seven years' water from the Tigris to fill it, and the amount which could be returned to the Tigris and Euphrates is problematical. It is possible that the Tharthar depression will be used solely to divert Tigris water to safety in years of exceptionally high floods when the reservoirs on the tributaries are full. Some wastage of Tigris water would thus occur, and stored water for irrigation in the plain will be released primarily from the dams on the tributaries. Thus the revived Nahrawan Canal, which is to issue from the Tigris near Balad, cross the Diyalah near Khan Beni Saad, and distribute water to the left of the Tigris as far as Kut, will be fed in the summer from the Greater and Lesser Zab rather than the Tigris. In plans now being formulated, the maximum possible storage on the tributaries is being essayed. The plans for the Dokhan Dam, now completed, provide for a greater height and hence reservoir level than in their first form. Meanwhile, only the first part of the Tharthar scheme, consisting of a barrage at Samarrah and a canal to divert flood waters westwards, is being undertaken. Thus the total of land which can be irrigated may be somewhat less than was envisaged by the Irrigation Development Com-

mission, on the basis of an assumed large storage of Tigris water in the Tharthar reservoir. The present intention is to await experience in the use of the depression as a receptacle into which Tigris flood waters may be diverted, before estimating afresh and with greater accuracy its capacity as a reservoir.

It may perhaps be asked whether alternative sites for the storage of Tigris flood waters have been investigated. This is so. On the analogy of the Tigris tributaries, the most effective control could be provided in the mountain reaches of the river, by means of a high dam or dams constructed at suitable gorges. Sites, however, exist only in Turkish territory.[6] There exists, however, a possible site within Iraq at Fathah, where the river cuts through the Jebel Hamrin. The Haigh Commission surveyed this gorge, but rejected it in favor of the Tharthar alternative, because its capacity would be insufficient, and because of the great danger to Baghdad if a dam at Fathah became breached by natural causes or a hostile act. (The Dokhan and Bekhmah sites will entail similar though smaller risks; and an independent expert committee has just re-examined the rock foundation of the proposed Dokhan dam. It has confirmed the choice previously made by the consultants.)

Considered in its entirety, the irrigation system which will slowly take shape in the coming decade (if works can proceed without interruption) will be perhaps the most complex in the world, for two main reasons. First, water is to be transferred from one tributary of the Tigris southwards to the next, in order to ensure that a maximum proportion of alluvial land on the left bank of the Tigris is commanded. For the restoration of the Nahrawan system, water from the Tigris will be added to a quota from the Diyalah. Secondly, the Tharthar depression (if utilized as a reservoir) will be used in conjunction with the Habbaniyah and Abu Dibis reservoirs, so that Tigris water can supplement Euphrates, and *vice versa*. For the purposes of irrigation, the two river basins will be integrated. Evidently, highly complicated operational rules will be required, and effective centralized control.

Finally, it is instructive to turn to the historical analogy offered by the development of irrigation in the Indian sub-continent. Indian experience and trained personnel have been applied to the problems of Iraq since the inception of the Mandate.[7] The Haigh Commission had its earlier parallel in the Indian Irrigation Commission (1901–1903). It is impossible not to discern a similarity between the Triple Project of the Punjab, completed in 1917, and the proposals to transfer water from one Tigris tributary to another. India, too, offers a time scale. From the earliest modern works in the Punjab and Sind (about 1850) to the full harnessing and utilization of the Five Rivers a period of about eighty years elapsed. Interruptions there were, notably during the Indian Mutiny and the First World War; but on the whole

[6] The disruption of the Turkish Empire in 1918 caused the Tigris-Euphrates basin to be divided between three states. Before 1918, political frontiers offered no obstacle to planning for the whole basin as a unit. The succession states would be unwilling to delegate part of their sovereignty to a supra-national authority; and, apart from the handicap to the control of the Tigris already mentioned, there is also potential conflict of interest between Iraq and Syria for the use of the Euphrates waters.

[7] It is perhaps necessary to mention that it was suggested during the 1914–1918 war that Iraq, after the defeat of Turkey, should become a part of the Indian Empire. Although this proposal was not carried out, administrators seconded from India were prominent when the mandatory government was being founded.

steady progress was assured by the *Pax Britannica* in the Indian sub-continent. The plans now being executed in Iraq cannot be completed for decades. Our final reflections as the first great works are begun must be hopeful but interrogatory. Is it possible that a degree of stability comparable with that enjoyed by the Indian sub-continent between 1858 and 1947 will prevail in southwestern Asia until the end of the present century?

NEW RAILROAD AND PORT DEVELOPMENTS IN EAST AND CENTRAL AFRICA

H. C. Brookfield

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SINCE 1945 the central and east African territories have undergone an economic revolution. Their raw material exports have increased enormously, and all colonial governments have been concerned to develop their territories in order that they might contribute to the economic recovery of the West. These large developments have severely taxed the transport facilities of the continent, so that further development is inhibited in some areas by difficulties of communications.[1] A number of schemes are in hand, or under discussion, and should they all reach completion, a radically different transport pattern will have been created.

The main developed areas of central Africa are remote from the sea, on the inland plateau of the continent. In this respect Africa differs markedly from, say, Australia or Latin America, where peripheral development is the rule. The developed areas of central Africa are almost equally accessible from a number of ports lying on both the east and west coasts of the continent. The present railroad system serving them springs from two origins: the great north railroad of Cecil Rhodes, linking central Africa with the Cape, and shorter lines to the east and west coasts where ports were created at Beira, Matadi, and Lobito to handle the traffic of the interior. The great north railroad terminates in the Congo, so that East Africa is served only by railroads from its own ports. This system developed about the turn of the century, and except for the Lobito and Matadi lines, has remained largely unaltered until the last few years (Fig. 1).

The political partition of Africa presents an incongruous picture when viewed in relation to a map of economic development—a pattern governed by resources whose nature and distribution has come to be known more recently. Boundaries cross areas of common economic interest, and outlets to the sea lie not infrequently through the country of another power. Territorial interest has played a large part in shaping the pattern of communications, and also plays a large part in the partition of the trade of the interior between the different outlets. Beira was developed by *Rhodesian Railways* and remains their principal port, though an agreement with *South African Railways* regulates the degree of preference they may give to this port. Very low port rates operate between South African ports and the Rhodesias for many commodities; thus Port Elizabeth in particular imports large quantities of goods for the Rhodesias, notwithstanding its dis-

[1] W. Marshall Clark, "African development curbed by transport difficulties," *Optima*, II, 2, June, 1952, 1–5.

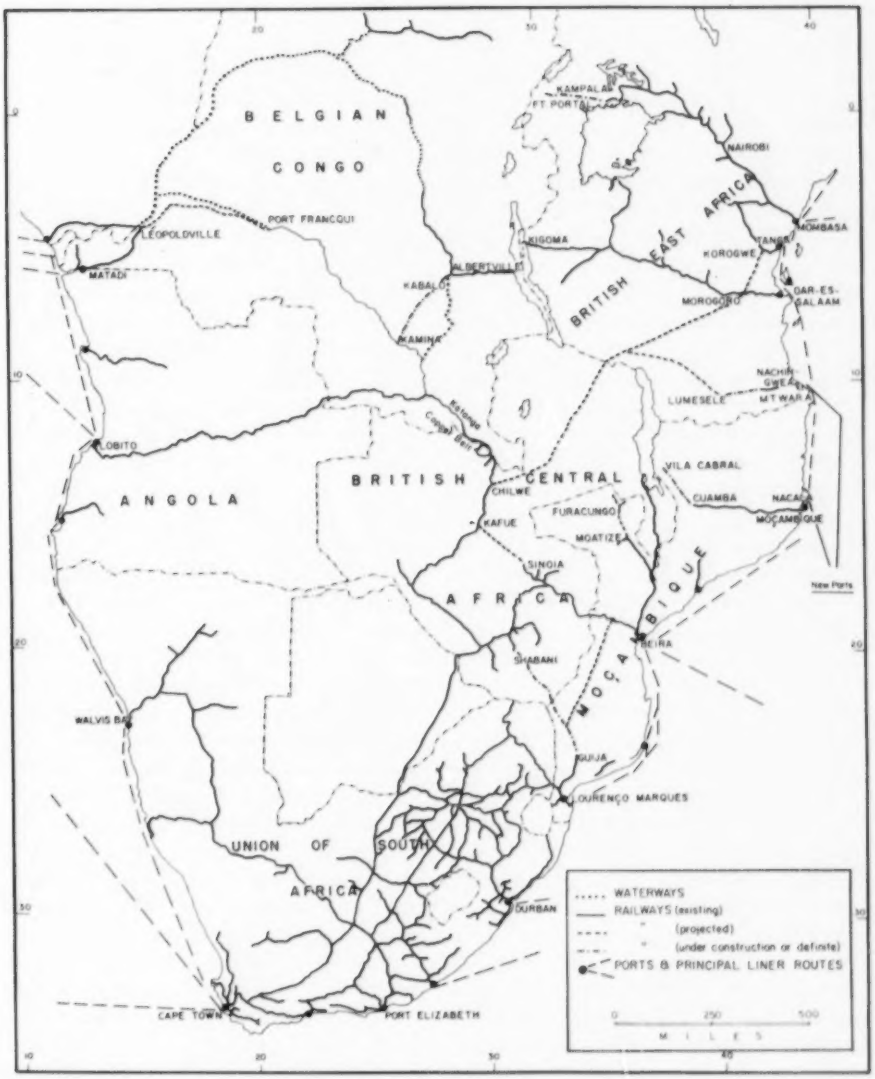

FIG. 1. Railroads and ports, showing proposed developments.

tance, and it may be cheaper to import cement, for example, into Northern Rhodesia via Durban than via Beira.[2]

[2] *Final Report* of a conference on the development and co-ordination of transport in central and east Africa, Johannesburg, 1950. Annexed document S2 ("On Lobito as an outlet for Northern Rhodesia.")

The outstanding example of the influence of territorial interest on the distribution of trade is in the Katanga and the Copper belt of Northern Rhodesia, and an examination of it will serve to illustrate the factors at work. Here the Congo-Rhodesia border, located

along the continental watershed, is also to a most marked extent a trade watershed between the Atlantic and Indian Ocean ports. Little Rhodesian traffic passes through Matadi or Lobito, and only a small proportion of Congo traffic passes through Beira. The Belgian *voie nationale* via Port Francqui, the Kasai river, Léopoldville, and Matadi shares the bulk of the Katanga traffic with the Portuguese Lobito line. The latter, completed in 1928, seemed capable of attracting traffic from Northern Rhodesia also, and in 1931 the company offered through "port rates" on this system as far as the Congo-Rhodesia border, which made Lobito a competitive alternative to Beira for the Rhodesian copper mines, only a few miles beyond. *Rhodesian Railways* had an agreement with the copper companies, by which they offered low rates on the mines' coal supplies, in return for a guarantee to ship copper over the Rhodesian system, but in addition quoted very low rates from Beira up to the Congo border in 1933, thus making Beira competitive to Matadi for Katanga shippers. By these indirect means, the Belgian company was induced to bring pressure to bear on the Portuguese to withdraw the low Lobito rates, and the status quo has been maintained to the present time.[3] The only other important foreign outlet for the Congo is through Dar-es-Salaam, where, under an agreement of 1921, Belgium has an extra-territorial enclave, and special rights over the Tanganyika Railway from Kigoma on the lake. No Congo traffic uses the French lower Congo outlet on the north side of the river.

POST-WAR TRAFFIC CONGESTION

This system of railways and the very variably equipped series of ports[4] were adequate for pre-war traffic, but have proved unable to cope with the post-war boom in traffic, particularly in the period of peak demand for raw materials which followed the outbreak of the Korean war in 1950. Congestion was particularly severe in Beira which was clogged by the enormous increase in Rhodesian trade, and in the East African ports where government traffic for the "groundnut scheme" and for the building up of a military base was added to the expansion of trade. Beira was for a time so congested that vessels were lying at anchor 90 days awaiting handling; the "conference lines"[5] imposed a 60 per cent surcharge on freights to compensate themselves for the loss of time and to encourage shippers to use other ports. In 1950 and 1951 large quantities of Rhodesian imports were landed at South African ports, but they congested the shed accommodation and the railways, so that many months elapsed before the backlog was cleared. Mombasa was also very crowded; in 1953 there was still a waiting list of several months length for cargo space to this port. Other ports suffered to a lesser degree, but no major port outside the Union of South Africa except Lourenço Marques and Lobito were able to handle comfortably all traffic offered.

A first result of this exceptional weight of traffic has been a great improvement in the efficiency of the whole system. For the most part railroad construction is light, and, outside the Union, only the Mombasa-Nairobi line, the Moçambique-Cuamba line, and the Lourenço Marques system are capable

[3] *Ibid.*

[4] Statistics of port facilities are given in: de Guingand, *ed., Africa South of the Sahara*, 1951, Chap. XVI, "Transport," by A. Freudenberg.

[5] "Conference Lines"—Lines belonging to the East African Shipping Conference, signatories to an agreement governing freight rates, allocation of quotas, and other matters.

of bearing an axle load greater than 18 metric-tons, and high speed traffic.[6] Among the ports, only Lourenço Marques, Matadi, and Mombasa have more than 3,000 ft. of well-equipped, deep water wharf. The relaying of many miles of track, the provision of new passing loops, and above all the import of many new locomotives and much rolling stock, together with the innovation of round-the-clock working at several ports have made possible considerable increases in capacity. However, in East Africa and above all at Beira these measures have not proved adequate. Beira's railway is constructed for a 15-ton axle load, its wharfage is small, its harbor, encumbered by shoals, is difficult to enter and leave, and shows some tendency towards shallowing at the entrance. A feature of Beira is the very great difference between neap and spring tides; minimum depth on the bar at neap high tides was only 16 ft. in 1950.[7] There is no question of the abandonment of this port, whose future use is guaranteed by a British-Portuguese-Rhodesian convention of July, 1950, and indeed it is intended to improve Beira's link with Northern Rhodesia by connecting Sinoia and Kafue, cutting out the Victoria Falls bend. However, provision of additional outlets for the very wide area dependent on this port has the first priority in the development of new routeways.

NEW RAIL ROUTES AND PORTS

Five new lines are under construction or in contemplation to serve Central Africa; in addition there are a few projects of more local significance. Some improvements in capacity, mainly involving increase of water supplies through the Bechuanaland desert, are being made on the old route from Rhodesia to the Union. This line has been heavily taxed in recent years by the growing Rhodesian import of South African manufactures and other goods, now over 450,000 tons per annum, so that there is less and less capacity available for traffic from Port Elizabeth. South African Railways have been carrying large quantities of goods for Rhodesia to Beit Bridge, on the Limpopo, and hope that Rhodesia will complete the rail-link from that point to Bulawayo. However, the effect of schemes now afoot will be to reduce Rhodesia's dependence on South African outlets.

1. *Lourenço Marques-Rhodesia*

This scheme, which is now under construction and due for completion in 1956, consists of a line from the Shabani branch, in the midlands of Southern Rhodesia, to Guija in Southern Moçambique, terminus of an existing line from Lourenço Marques. The work is being undertaken jointly by *Rhodesian Railways* and *Caminhos de Ferro de Moçambique*. Its cost was estimated between five and six million pounds sterling, and construction has been aided by a loan from the World Bank. The line follows a course everywhere outside the Union of South Africa, and has been selected in preference to the shorter Beit Bridge link. Its main function will be to connect Rhodesia to one of the best harbors and best equipped ports in southern Africa, a port which has not been overtaxed in recent years, and which may be sufficiently far south to tempt an extension of the rapid Europe–South Africa shipping services to serve Rhodesian traffic. Lourenço Marques also will be the nearest seaport after Beira for the country right up through Northern Rhodesia as far as the Katanga,

[6] Johannesburg conference, *Final Report*, Statistical appendices.

[7] British Admiralty Chart No. 1003, "*Approaches to Porto da Beira*," 1952.

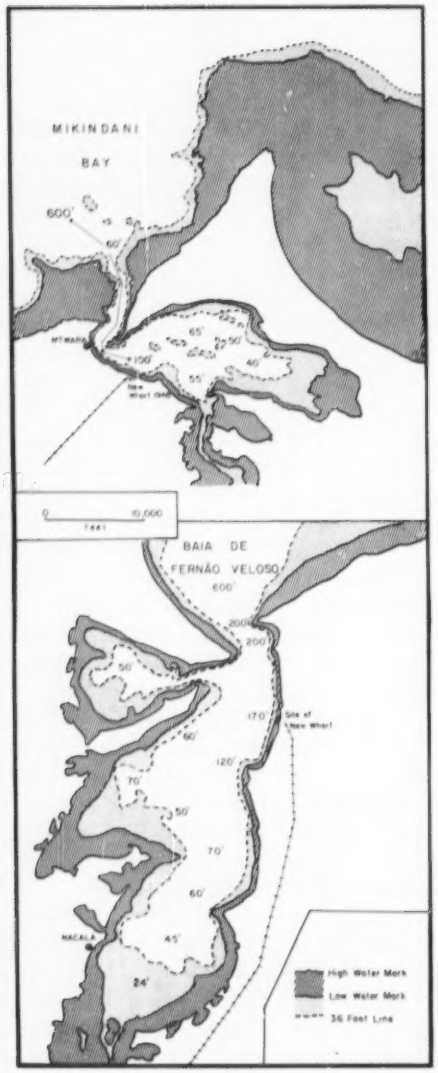

FIG. 2. The new ports: above, Mtwara; below, Nacala. (Based on British Admiralty Charts, Nos. 684 and 1809, by permission.)

particularly when the Sinoia-Kafue link is built. The port may become the principal outlet for the new Federation, and thus advance to a much higher status among the ports of Africa. The *C.F.M.* section of the line will also form part of a contemplated link between Lourenço Marques and Beira.

2. *Nacala*

The second new outlet is for the more distant future, but has great promise (Fig. 2). It also lies through Portuguese territory. The short Moçambique railroad was extended to Cuamba some years ago, and soon is to be extended further to Vila Cabral in the Niassa highlands, to open up an empty area intended for European peasant colonization. It will run very close to the border of Nyasaland, and the Portuguese hope that the line will be extended into Nyasaland, providing that country with a second seaport. They hope that this line may ultimately be extended across Nyasaland into the middle Zambezi valley and the Rhodesias.[8] The line has been constructed in an exceptionally sturdy manner for an African railroad, and is designed for far heavier traffic and higher speeds than the present cotton, tea, and tobacco traffic requires. A branch line has been built at the seaward end to the harbor of Nacala, fifty miles north of Moçambique, where it is intended to build a first class modern port in place of the old port to the south. Nacala has beyond doubt the finest harbor in eastern Africa and one of the best in the world. Its entrance is approached through the wide and deep bay of Fernão Veloso, and is completely sheltered, half a mile wide and 200 feet deep. Within is an enclosed water area eight miles long and from two to four miles wide, nowhere less than 36 feet deep, and with deep water close to the shore along the eastern side of the harbor.[9] It is intended to build a

[8] C. F. Spence, *The Portuguese Colony of Moçambique*, 1951.

[9] British Admiralty Chart No. 1809. "*Porto de Moçambique to Ras Pekawi*" (1950).

deep-water wharf here, by the new railroad terminal, and the work has been given first priority by the Moçambique government when the present improvements at Beira have been completed. Unfortunately, little enthusiasm has yet appeared from the British side for the proposed extension of this line into Nyasaland and beyond. The Nyasaland railway is British owned right down to Beira, so that the company has a strong interest in the latter port.

3. *Rhodesia-Tanganyika Link*

The third proposal is on the scale of Cecil Rhodes great line into Rhodesia from the Cape. It is a plan for a 1100-mile link between the Rhodesian and Tanganyikan systems, with a 400-mile branch to a new port at Mtwara, in the extreme south of Tanganyika, which has been developed on a small scale in connection with the British government groundnut scheme. Mtwara, like Nacala, is a very fine, undeveloped natural harbor, with a large enclosed deep-water area.[10] Its handicap is its entrance, which is very tortuous and at its narrowest only 700 feet wide. It is, however, by far the best harbor in Tanganyika, and since 1948 has had a small deep-water wharf and a railroad to Nachingwea. The port was fully opened to deep-sea traffic in early 1954, and work recently commenced on a 40-mile extension of the railroad west of Nachingwea. The potential hinterland of Mtwara, in the little developed Southern Province of Tanganyika, includes the cool and well watered Iringa and Mbeya highlands, two of the small islands of cooler and moister conditions which are so marked a feature of inter-tropical Africa, and close to the northern end of Lake Nyasa a rich coal field has recently been proved.

[10] British Admiralty Chart No. 684, "*Mtwara and Mikindani Harbours*" (1950).

The Rhodesia-Tanganyika link was surveyed between 1949 and 1951, but it is still doubtful whether or not it will be constructed. The cost has been put at 33 million pounds sterling ($90 million) for the main line and 18 millions ($40 million) for the branch. It runs almost all the way through empty bush, some of the most useless country in the world, and the only areas of immediate value would be served by the Mtwara branch. On the other hand it would provide two further outlets for the Central African Federation, through Mtwara and also Dar-es-Salaam, at present only a lighter port, albeit an important one, with a most difficult entrance for large vessels. This is now being improved by extensive dredging and a new deep-water wharf is under construction. It is intended to continue the Tanganyika line to join up with the Kenya system. A committee appointed by the British Colonial Office to examine possibilities of the two lines reported unfavorably in October, 1952, but the belief has remained that the line will be constructed. In November, 1952, the British Government sought powers to borrow a large sum for *Rhodesian Railways* and *East African Railways* jointly, though not a sufficient sum to complete these lines.[11] There are obvious strategic merits in this project, joining the detached East African area, at present with a narrower gauge track, to the South African system.[12]

4. *Kamina-Kabalo*

The remaining two schemes concern the Belgian Congo. Work was com-

[11] *Hansard, British Parliamentary Debates (Commons)*, November 14th, 1952, Colonial Loans Bill, Second Reading, also *The Times Review of the British Colonies*, Winter, 1952, 3, "African Railway Link."

[12] The East African system is constructed on a gauge of 1 metre.

FIG. 3. The entrance to Dar-es-Salaam.

menced in April, 1953, on a new line to link the Katanga directly by rail with Albertville, the Belgian port on Lake Tanganyika. It will run from Kamina, on the Katanga-Port Francqui line to Kabalo, thus cutting out the navigation of the upper Congo. With this will be associated an increase in Belgian traffic over the Tanganyika system. One of the three new berths at Dar-es-Salaam is allotted to the Belgians. This line will bring not only the easternmost districts of the Congo, as at present, but also the Katanga within the potential hinterland of Dar-es-Salaam. Under a different railway policy it may also serve another purpose, that of drawing traffic from the eastern districts of the Congo towards Matadi: it has hitherto been Belgian policy to make the Matadi outlet at least equally competitive with all other outlets throughout the Congo, even in those areas which are much closer to competing foreign ports.[13]

5. *Port Francqui-Léopoldville*

The last major scheme is the proposed railroad between Port Francqui and Léopoldville, to provide a through line of rail between the Katanga and Matadi and to cut out the long water route of the Kasai, a distance equal to the navigable course of the Rhine. In addition, the Matadi-Léopoldville line is to be double-tracked, and ultimately electrified. This proposal, though generally accepted in Belgian quarters, has come under strong criticism on economic grounds. It is held that the very low cost of water transport on the Kasai, as compared with the higher cost of transport on the proposed railroad, is not offset by the double handling costs at each end, so that the mixed route remains cheaper than a potential all-rail route. To this criticism is added the argument that the more costly all-rail route, when completed, would have to compete for its traffic in the Katanga with a shortened route to Beira, through the Sinoia-Kafue link, with the new route to Lourenço Marques, and also with the new route to Dar-es-Salaam via Lake Tanganyika. This competition could be met, so runs the argument, only by a national policy of freight rates designed to force traffic onto the "*voie nationale.*" The argument is not conclusive either way, but, though the line has been surveyed, no work has yet commenced.[14]

6. *East African Developments*

In addition there are a small number of schemes which have no connection with central Africa. Principal among these is the extension of the Kenya and Uganda railway westward from Kampala to Kilembe and Lake George in western Uganda, of which the first section has been completed. This will greatly assist the development of this important region of native agriculture, will open up the copper of Kilembe, and will also attract traffic to Mombasa from the northeastern districts of the

[13] O. Jadot, "Le programme ferroviare du Congo Belge," *Bull. de l'Institut Royal Colonial Belge*, XXII, 1952, 522–544.

[14] *Ibid.*, and E. J. Devroey, "La rivière Kasai et la voie nationale du Bas-Congo au Katanga," *loc. cit.*, 629–666, and G. Bousin, "Quelques considerations sur 'la voie nationale des transports congolaises'," *loc. cit.*, 685–697.

Belgian Congo. At present a small trickle of traffic passes this way. The problem of improvements at Mombasa is being eased by the extension of the excellent deep-water wharf. This port has, in Kilindini,[15] probably the finest area of land-locked deep water in eastern Africa, after Nacala, though its entrance is a restricting factor. There is ample room for expansion. Recently a commission of enquiry investigated the causes of congestion at Mombasa and recommended further wharf extensions. Mombasa is becoming an industrial port: a cement factory is under construction and an oil refinery is soon to be built. At present nearly half the tonnage of goods carried by rail up to Nairobi is oil. The railway, indeed, is the limiting factor at Mombasa. Though constructed on very sound lines and greatly improved in recent years by the provision of many more passing loops, it is heavily taxed. Possibly the proposed juncture with the southern African system may provide an opportunity for widening the gauge from the present metre width to the standard 3 feet, 6 inches, thus increasing the capacity of the line. Such a link, entering the northern system at Korogwe, would also increase the hinterland of the sisal port of Tanga. Here a new deep-water wharf is proposed in place of the existing very inadequate lighter wharf. As it stands, Tanga is little better than a roadstead.

AFRICA LOOKS EAST

A common feature in these several proposals is the greater significance they give to the Indian Ocean shore of the continent. Already, ports are more closely spaced on this coast than on the west, and two more are to be added, in two of the best harbors in Africa. The rail network is to become much denser on the eastern side than on the western, and, with the probable exception of the "*voie nationale*" through Matadi, it is more than probable that the west coast share in the trade of central Africa will diminish further. At present Lobito has little Rhodesian trade, but about 50 per cent of its traffic is with the Congo. In the future, however, it is likely that developments in Angola itself will use more and more of the capacity of this route. The Rhodesian desire for a west-coast outlet, which is based on emotional rather than rational grounds, has been the subject of debates in the Rhodesian House of Assembly as recently as June 22, 1949, and May 31, 1950. However, on February 14, 1951,[16] a ministerial statement was made on Rhodesian transport development which gave first priority to the Lourenço Marques line and second priority to improvements on the Beira line, placing the west coast outlet as a matter for consideration in the distant future.

Beyond doubt, important changes will appear in the pattern of Indian Ocean shipping. Already the east coast of Africa has advanced far from being a backwater of world shipping: it is served by eleven "conference" lines from northwest Europe, and three from the United States, and has in addition links with the Far East, provided by at least four lines. A peculiarity of this coast is that it is approached from Europe and America both from north and south, via Suez and the Cape. Most vessels coming via Suez have their main business in East Africa, though the majority proceed to Beira, and some circumnavigate Africa. Most vessels coming via the Cape have much

[15] Kilindini—"the place of deep waters."

[16] *Rhodesian House of Assembly Debates*, 22.6.49, 31.5.50, 14.2.51, and R. Welensky, "Towards Federation in Central Africa," *Foreign Affairs*, 31, 1, October, 1952, 142.

of their business in the Union, though some miss all or most Union ports and serve principally Lourenço Marques and Beira. Beira, equidistant from Europe in either direction, serves as a terminus for lines sailing both ways. The new function of Lourenço Marques as port for Rhodesia will undoubtedly lead to an increase in the demand for cargo space at this port, which may induce further skipping of Union ports, and the development of shipping routes serving southeast Africa more exclusively than at present. Nacala, only recently opened to traffic, is at present served by the two Portuguese lines which approach via the Cape, though in May, 1953, the leading British conference line put one of their passenger-cargo lines into this port for the first time. This ship sails to the United Kingdom via Suez. In its development, Nacala will have, in common with Mtwara, the handicap of being on a coast at present lean in cargo space, which is mainly engrossed at ports on either side of the new havens. This may fortify the tendency to break down the present system and for a new pattern of liner routes to emerge. It is unlikely that tramp shipping will play much part in this development: eastern Africa is poor in tramp cargoes and even in the recent boom, tramps have played only a minor role, except possibly at Beira. The existing relative profusion of liner services on the east coast has been one factor in aiding development of traffic and hence of new routes; in their turn the new transport developments will enable further improvements to be made in the liner services, which may then encourage yet further development. One noteworthy point is that the nature of the harbors at present in use limits liners on the east coast to little more than 20,000 tons in size. One or two ports, particularly Nacala, Lourenço Marques and Mtwara after improvements, and possibly Mombasa are, however, capable of handling vessels much larger than this. This may in time prove to be an important differentiating factor, as it has elsewhere in the world.

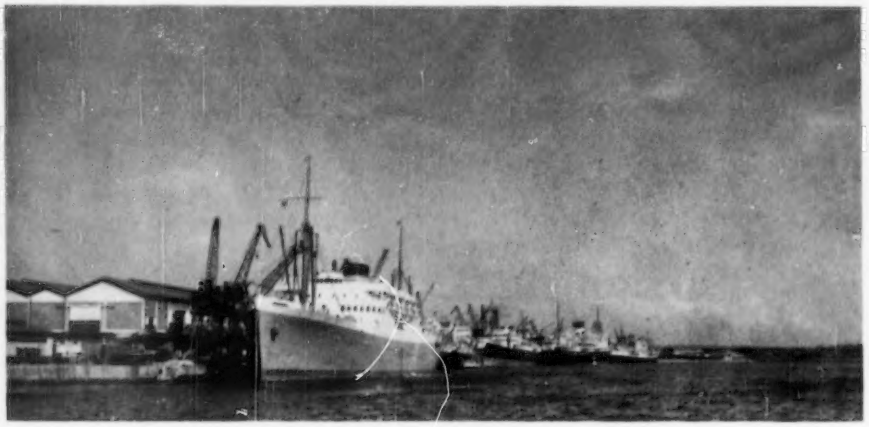

FIG. 4. The deep-water wharf at Kilindini, Mombasa. The vessel in the middle distance, 17,000 tons, is the largest type of vessel at present in service in the East African ports.

There is one background factor in all these developments which has hitherto only been touched on, but which,

none the less, is of the greatest importance. The strategic significance of the Indian Ocean coast of Africa to the West has increased enormously since the loss of all but a toehold on the coast of the Asiatic mainland. For the defense of the Indian Ocean, and possibly of Africa itself, a chain of well-equipped ports in Eastern Africa backed by an inter-connecting railroad system would be invaluable. The decision whether or not to proceed with the Rhodesia-Tanganyika link may well depend rather on an appraisal of its strategic significance than on its commercial value. Likewise, it may be that a realization of its strategic value will lead to the earlier integration of Nacala in the Southern African transport system than at present seems possible. The value of trans-African railways between Matadi and Lobito on the one hand and Nacala, Mtwara and Mombasa on the other, would be enormous in a time of intense submarine onslaught on the long shipping routes round the Cape. Such a link would have been of immense value in 1939–1945, when losses to submarines were heavy round South Africa and when, at one black period, the British Fleet in the Indian Ocean fell right back on Mombasa and Durban as its bases.

International and inter-territorial co-operation, whether dictated by a genuine spirit of neighborliness, or by a realization that herein lie the best interests of the African continent as a whole, or whether brought about simply by strategic necessity in face of a common danger, is vital if a sane and logical pattern of transport is to be evolved for the African continent. This realization inspired a series of conferences between the authorities concerned at Lisbon in April, 1949, in Paris in February, 1950, and finally in Johannesburg in October, 1950, where information was pooled and an attempt made to arrange international cooperation on schemes for development, railway rates, and administration. Though the conferences provided a valuable clearing house for information and ideas, and an attempt was actually made to set up an international secretariat at the final meeting, nothing lasting has resulted from all this work, and, barring local agreements, the different authorities still think and plan on national lines. Without a fresh international approach, it seems likely that even greater competition than before will result. In a continent whose governments are increasingly divided on human and economic issues, this failure to think internationally on transport is symptomatic of a failure to comprehend the underlying unity of Africa. It may be fitting to remark, in conclusion, that

FIG. 5. Loading copper at Beira. Every berth in this port is used continuously, so that vessels must also be worked lying in midstream

this new transport system is being forged for the further development of the continent through the European immigrant; however, recent events in Kenya, South Africa, and elsewhere all point to the growing anxiety of the African to play a larger part in the affairs of his own land—a desire which, if thwarted for too long, may yet lead to the violent collapse of the whole structure of modern African development.

Postscript (September, 1954): Since this article was written, a completely new system of rail tariffs has been introduced in South Africa. Apart from its internal effects on the location of industry, and the relative position of rail and coastal transport, which will be considerable, the new schedule does away with the cheap Port Rates referred to on page 62, and is therefore likely to reduce sharply the volume of transit traffic between Union ports and the northern territories. Also, discussions have recently been held between *Rhodesian Railways* and *Caminhos de Ferro de Benguela* with a view to increasing the flow of Copperbelt traffic through Lobito Bay. A plan has been proposed for a new Copperbelt-Lobito line through western Northern Rhodesia to join the existing line in central Angola, but no action is likely to be taken for some years.

AN ANALYSIS OF ISOPLETH AND CHOROPLETH CLASS INTERVALS

J. Ross Mackay

Associate Professor Mackay of the Department of Geology and Geography, University of British Columbia, has contributed three previous articles on cartographic techniques to ECONOMIC GEOGRAPHY. *Such studies are of value to the economic geographer both in analysis of data and in presentation of his findings.*

CLASS intervals are the conveniently sized groups into which line and area symbols divide distributional data. The number and variability of class intervals greatly affect the accuracy, usability, legibility, and attractiveness of maps. Since the original statistical data from which isopleth and choropleth values have been calculated are not shown on maps, the reader sees only those particular values which the cartographer has emphasized through his choice of class intervals. The selection of class intervals is probably the most important problem which the cartographer must face in using isopleths and choropleths.[1]

Poorly chosen class intervals may nullify much of the value of a map. It is the purpose of this paper to consider several techniques which may be used in the judicious selection of class intervals for isopleth and choropleth maps. Isopleths are here defined as the line symbols which represent quantities, assumed to be constant, pertaining to certain specified areas through which they pass; choropleths as the area symbols that represent quantities pertaining to statistical divisions.[2] Both isopleths and choropleths show different types of relationships, such as density of population or average size of farm. Some of the following discussion applies also to isometric lines (lines of actual constant value, such as altitude) but for several reasons these maps pose particular problems of their own and so should be considered separately.[3]

The cartographer can use an endless variety of class intervals in analyzing statistical data for a map but he is effectively restricted to a small number of class intervals—usually less than ten—when he drafts a map. Class intervals are the mesh sizes of cartography with isopleth and choropleth values forming the screen wires. The meshes should be wisely chosen so that each class interval plays a full role in size-sorting the distributional data. They should not be so fine in any part of the scale that inconsequential details are sifted out to clutter up the map, neither should they be so coarse that significant differences pass through and are lost.[4]

[1] Arthur H. Robinson: "Elements of Cartography." New York, 1953, p. 173. Although the reference is to isolines of which isopleths are one type, the statement applies with equal validity to choropleths.

[2] J. K. Wright: "The Terminology of Certain Map Symbols," *Geogr. Rev.*, Vol. 34, 1944, p. 653.

[3] For example, see the symposium on contour intervals in *Surveying and Mapping*, Vol. 12, No. 4, October–December, 1952.

[4] Maps showing the same statistical data plotted with different class intervals are given in: J. K. Wright: "Map Makers Are Human," *Geogr. Rev.*, Vol. 32, 1942, p. 535, Fig. 2; and J. Ross Mackay: "Some Problems and Techniques in Isopleth Mapping," *Econ. Geog.*, Vol. 27, 1951, p. 7, Fig. 4.

GRAPHIC AIDS

Class intervals which are expressive of distributional data are not easily determinable by visual inspection alone. Rather, class intervals should be chosen with meticulous care by utilizing special techniques for their study and the potential combinations should be put to practical tests on sketch maps. Frequency, cumulative, and clinographic curves are three graphic aids that may be used in the selection of class intervals. Graphic aids do not cease to be of value after they have served their initial purpose in the study of class intervals, for they can often be employed to supplement the maps by elucidating other facets of the distributional data.

Frequency Graphs

Frequency graphs are the everyday tools used by statisticians in the selection of class intervals. The class interval grouping is normally scaled off along the horizontal X axis (abscissa) and its frequency of occurrence along the vertical Y axis (ordinate). The common precipitation diagram is such a graph with class intervals expressed in months along the X axis and frequency of precipitation expressed in inches along the Y axis. When rectangles rather than a line are used to show the data, as in the step-like profile of the "battleship" precipitation diagram, the chart is often termed a histogram or rectangular frequency polygon.

An illustration of the use of a frequency graph in the selection of class intervals for a population density map of the United States has been given by Alexander and Zahorchak.[5] Densities were scaled along the X axis and number of counties (i.e., frequency of occurrence) along the Y axis. Marked depressions in the graph were used to establish the limits of the class intervals, because: 1) such limits generally result in fewer isolated "highs" and "lows"; 2) groups of related densities tend to be kept together; and 3) unrelated densities tend to be segregated. The authors have pointed out a weakness in the graph, namely its inability to take into account areal distributions, because the counties which cumulate into a high frequency total on a graph may be widely separated geographically on a map.

The units which are scaled along the Y axis should be the same, or at least so comparable that any differences do not appreciably affect the accuracy of the graph. As an example, let us consider a frequency graph for the population density of Canada where densities are scaled off along the X axis and number of counties or census divisions along the Y axis. In 1941 the areas of the 250 county and census divisions varied from a low of 72 square miles for Ile-d'Orléans to a high of 1,258,217 square miles for the Northwest Territories with a great range of intermediate values.[6] Since the county and census divisions were not comparable in size, no significance could be attached to marked depressions in a frequency graph. It would be virtually useless and extremely misleading. Quite clearly, the more the divisions vary in size the greater is the inaccuracy of a frequency graph which is based upon the *number* of divisions. However, if the Y axis were scaled off in area (e.g., square miles), then the frequency graph could be used, because the weighting of the divisions would be in proportion to their sizes. If statistical divisions differ

[5] J. W. Alexander and G. A. Zahorchak: "Population-Density Maps of the United States," *Geogr. Rev.*, Vol. 33, 1943, pp. 457–466.

[6] *Eighth Census of Canada*, 1941, Vol. II, Dominion Bureau of Statistics, Ottawa, 1944, pp. 5–8.

by more than a few per cent in size, it is preferable to scale the Y axis according to area instead of number in order to have an accurate graph.

Cumulative Graphs

The frequencies in a cumulative graph are successively totalled so that the data at any point represents the sum of all the preceding. In statistics and related studies, the variable is usually scaled along the X axis and the cumulative frequency along the Y axis. An *ogive* is a cumulative graph where the reverse is done, the cumulative frequency is scaled along the X axis and the variable along the Y axis.[7] The normal ogive is S-shaped and expressable by a mathematical equation.[8] The hypsographic curve, which is used in many geography books to show the areas of land and sea at different heights and depths, is an ogive where the cumulative frequency (area of land and sea) is along the X axis and the variable (altitude and depth) along the Y axis.

Whenever area is involved, an ogive is usually more suitable for geographic comparisons than a "normal" cumulative curve because we tend to visualize isopleth and choropleth values as varying vertically—like the altitudes represented by contours—rather than horizontally. For a similar reason bars in a rainfall diagram are plotted vertically rather than horizontally. It is easy to determine by visual inspection of a cumulative curve what fraction of the map area will lie within the limits of any class interval, even though non-contiguous map areas are involved. As an illustration, Figure 1 is a cumulative graph prepared for the 1941 population density of Canada based upon some 250 county and census divisions. The graph shows at a glance that if an arithmetic progression of uniform class intervals of "20 per square mile" were used, the first class interval of 0 to 20 would enclose well over 95 per cent of Canada's entire map area, leaving considerably less than 5 per cent for all the remaining intervals.

On all choropleth maps, and on isopleth maps where the areas between lines are patterned or colored, it is general cartographic procedure to have class intervals at the lower end of the scale cover the largest map areas and those at the upper end the smallest. Such a practice is aesthetically desirable because the intensity of patterning or coloring is almost invariably chosen to increase from low to high values, and it is well known that large areas of dark patterns or intense colors are displeasing to the eye.[9] Cumulative graphs may assist cartographers to design more attractive and balanced maps by enabling them to determine what proportion of any map will lie enclosed within each class interval throughout the entire scale. Cumulative curves of different distributions can be plotted and compared on a single graph to facilitate the discovery and portrayal of interrelationships: e.g., ogives of density, population, altitude, mean annual precipitation, and size of farm can readily be compared for the same area and their interrelationships studied.

Clinographic Graph

The clinographic curve or graph is used in landform analysis to show the

[7] J. G. Peatman: "Descriptive and Sampling Statistics," New York, 1947, p. 123.

[8] C. C. Peters and W. R. Van Voorhis: "Statistical Procedures and Their Mathematical Bases," New York, 1940, pp. 426; 435–436.

[9] For the visual aspects of patterns and colors, see Robinson, *op. cit.*, pp. 126–133; 177–179.

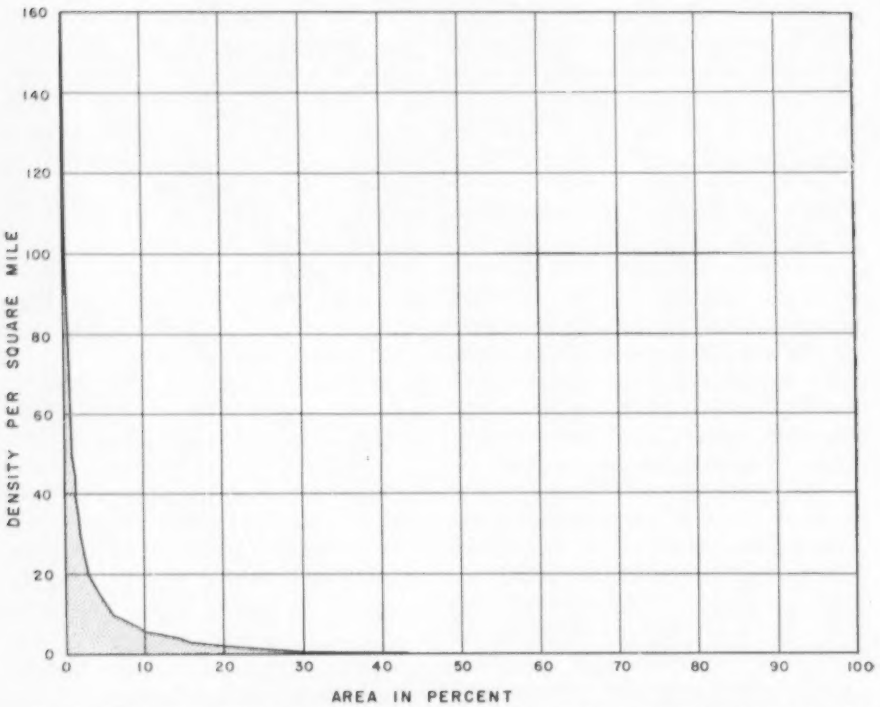

FIG. 1. This is a cumulative graph for the population density of Canada prepared from the 1941 census data and based upon some 250 county and census divisions. The graph enables a person to determine what per cent of the area of Canada would lie within any class interval or sequence of intervals. For example, if intervals were at densities of 0–20–40–60–80 . . . people per square mile, over 95 per cent of Canada's area would lie within the limits of the 0–20 interval. By the use of the graph it is easy to ensure that class intervals at the low end of the scale cover larger areas than those at the high end, thus avoiding large areas of dark shades or strong colors on a map.

average profile of the land.[10] The clinographic curve for the study of class intervals is constructed by calculating the areas lying above each successive isopleth or choropleth value from the lowest to the highest. The curve can be drawn before plotting the data on a map, because isopleth and choropleth values pertain to statistical areas such as civil or census divisions. If the total area enclosed by the smallest isopleth or choropleth value is represented by A_1 (this is usually the entire map area), the total area enclosed by the second smallest isopleth or choropleth by A_2 and so forth, then the areas of A_1, A_2 . . . A_n, can be replaced by concentric circles of proportionate area. The radii (R) of the circles are derived by calculating R from the equations $A_1 = \pi R_1^2$, $A_2 = \pi R_2^2$ . . . $A_n = \pi R_n^2$. As π is constant, the radii are in proportion to $\sqrt{A_1}$, $\sqrt{A_2}$ . . . $\sqrt{A_n}$. A cross-section or profile through the center of the concentric circles gives an average

[10] The clinographic and hypsographoid curves are identical. The hypsographoid curve was first drawn by F. Uhorczak of Lemberg (E. Raisz: "General Cartography," 2nd Edit., New York, 1948, pp. 281–282) and the results published in 1931. A similar idea was later expressed by J. Hanson-Lowe: "The Clinographic Curve," *Geological Mag.*, Vol. 72, 1935, pp. 180–184. "Clinographic" is preferred in this paper to "hypsographoid" because it suggests slope and the prefix is made familiar by words such as clinometer, anticline, syncline, and incline.

profile of the area. Since the profile will form two symmetrical halves, only the semi-profile need be used, i.e., from outermost circle to the center. The profile is drawn in the same manner as a topographic profile except that isopleth or choropleth values are scaled off on the Y axis instead of altitudes. The slopes can also be determined by simple calculation with the use of tangent tables. In the case of landslope analysis, the X and Y axes are expressable in the same units, e.g., feet; but with isopleth and choropleth maps, the units are different, e.g., miles and density. However, this need cause no concern, because the usefulness of the clinographic curve is not affected by a difference in units. For example, a clinographic curve could be drawn for an island with a contour interval of 20 feet. It is self-evident that if population density followed the same pattern as the topography with a perfect numerical correspondence existing between population density values and altitude, clinographic curves of each would be identical. The essential difference would be the absence of any relationship involving vertical exaggeration between X and Y scales in the population density clinographic curve.

It would obviously simplify the drawing of clinographic curves if it were unnecessary to convert areas (A_1, A_2 . . . A_n) into radii (R_1, R_2 . . . R_n) and the data could be plotted directly onto graph paper. This can be done quite easily on arithmetic-square root or "clinographic paper" in which the X axis is divided according to the square root of the number represented, e.g., 1 is at a distance of $\sqrt{1}$ from the origin, 2 at a distance $\sqrt{2}$, 3 at distance $\sqrt{3}$, and n at distance $\sqrt{n}$, the Y axis being ruled off arithmetically. Although arithmetic-square root paper may be commercially available, the writer is not aware of where it may be obtained. It can be drawn with the use of graph paper and a table of square roots, or else the spacings of the lines on the X axis may be obtained with slight modification from binomial probability paper (square root-square root graph paper). Arithmetic-square root paper is also ideal for plotting square roots. To use the arithmetic-square root paper, areas (or areas expressed in per cents) are marked off along the X axis. Since R is in proportion to $\sqrt{A}$, the square root scale of the X axis transforms areas into radii of circles of proportional area. By plotting the values of the isopleths or choropleths along the arithmetically ruled Y axis, a clinographic curve is obtained directly without any calculation (Figs. 2 and 3). The data which is used in the plotting of frequency and cumulative curves needs only slight rearrangement to be plotted in the form of a clinographic curve. Cumulative totals may also be read off directly from a clinographic curve.

Since the clinographic curve shows average slopes, it is ideal for the study of changes or breaks in slope. There must be causative factors to explain why a curve flattens or steepens at a particular point. If the breaks in slope are of geographical significance, they should be considered when class intervals are chosen.

Frequency, cumulative, and clinographic curves should be used to supplement each other and not employed separately, because different combinations of class intervals will usually be suggested by each graph. The final decision should be based upon an examination of all three graphs together with whatever additional information is available and the class intervals tested on a map.

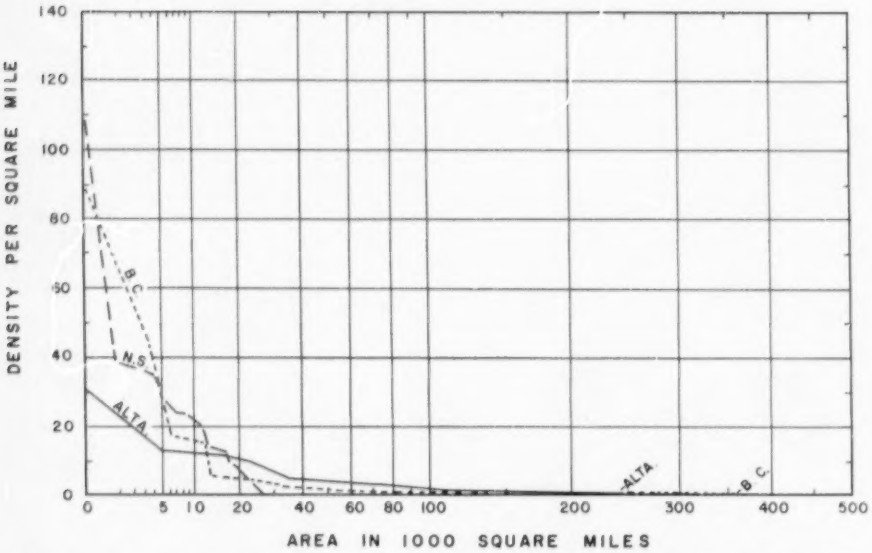

FIG. 2. Clinographic curves for the population density of the Provinces of Alberta, British Columbia, and Nova Scotia are shown for 1941. The areas of the provinces are marked along the X axis and density per square mile along the Y axis. The curves give average density "profiles" and can be readily visualized if they are considered to be similar to topographic profiles, but with density replacing altitude. The X axis is ruled on a square root scale, e.g., 100 is at a distance of 10 and 400 at a distance of 20.

VALUES OF CLASS INTERVALS

Class intervals may be constant or variable; when variable, they may change systematically or randomly. In order to obtain representative statistical data on class intervals, sequences were tabulated from ten well known geography textbooks, five atlases, and five periodicals (years 1951–52). The class intervals were reduced to the same common denominator for comparison purposes by making the *first* class interval of each sequence equal to *one*. For example, if choropleths were at densities of 0–50–100–200 people per square mile, the sequence would become 0–1–2–4 when divided through by 50, the value of the first class interval. The method of reducing the intervals to a common denominator proved satisfactory for most maps, but there were some exceptions. As an illustration, if isopleths were at densities of 50–100–200 people per square mile, the first class interval would be 50 or less, the precise value usually being unknown without additional data. It was found in most instances that such a sequence could reasonably be assumed to start at or near zero, but all dubious cases were omitted from the tabulations.

The averaged density of population sequences are shown in Figure 4 with rainfall and altitude curves added for comparison. The combining of polyglot data from many maps may not be in the best statistical tradition, but since the resulting data are not randomly distributed and do reveal certain trends, they are not without interest. The results have been plotted on semi-logarithmic paper so that the rates of change of the class intervals are shown by the slopes of the curves. Since the curves generally flatten with an increase

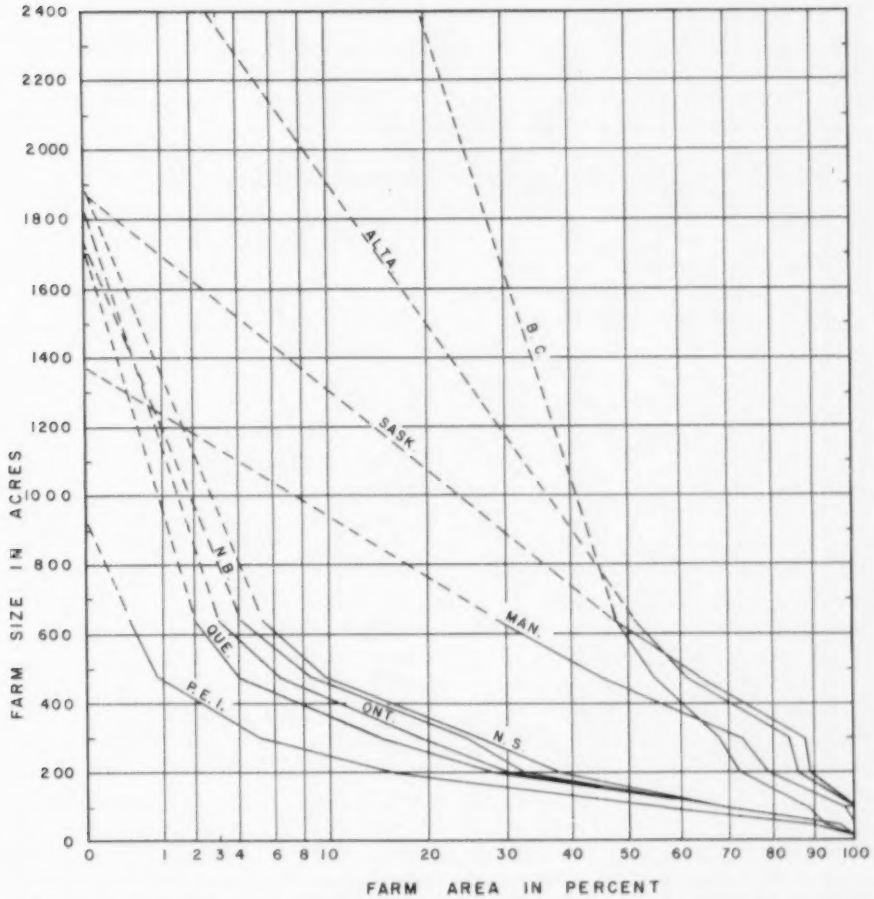

FIG. 3. Clinographic curves of the average farm sizes for the Canadian Provinces are shown for 1941. The X axis is marked off in per cent and not in area, as in Figure 2. Since there is no statistical breakdown for farm sizes above 640 acres, the dotted lines have been drawn by determining the average sizes of the farms over 640 acres and then the lines have been projected. The curves show "farm size" profiles which fall into two groups: Prince Edward Island, Quebec, Ontario, New Brunswick and Nova Scotia have concave profiles, whereas those of the three Prairie Provinces (Manitoba, Saskatchewan and Alberta) and British Columbia are almost straight. The abrupt breaks in slope of the various curves are primarily due to the systems of land-survey and the statistical groupings used in the census, whereas the size ranges of the farms reflect not only land-survey units, but utilization of the land. For example, British Columbia has more of its area in small farms than Manitoba and also more in large farms.

in the number of class intervals, their rates of change are greatest at the low end of the scale although their numerical values usually increase up the scale.

The tendency to increase the numerical values of the class intervals from the low to the high end of the scale in density, hypsometric, and rainfall maps —as with many other types of maps— reflects several factors, principally that these types of geographic distributions generally have large areas with low values and small areas with high values. Within many regions extensive areas

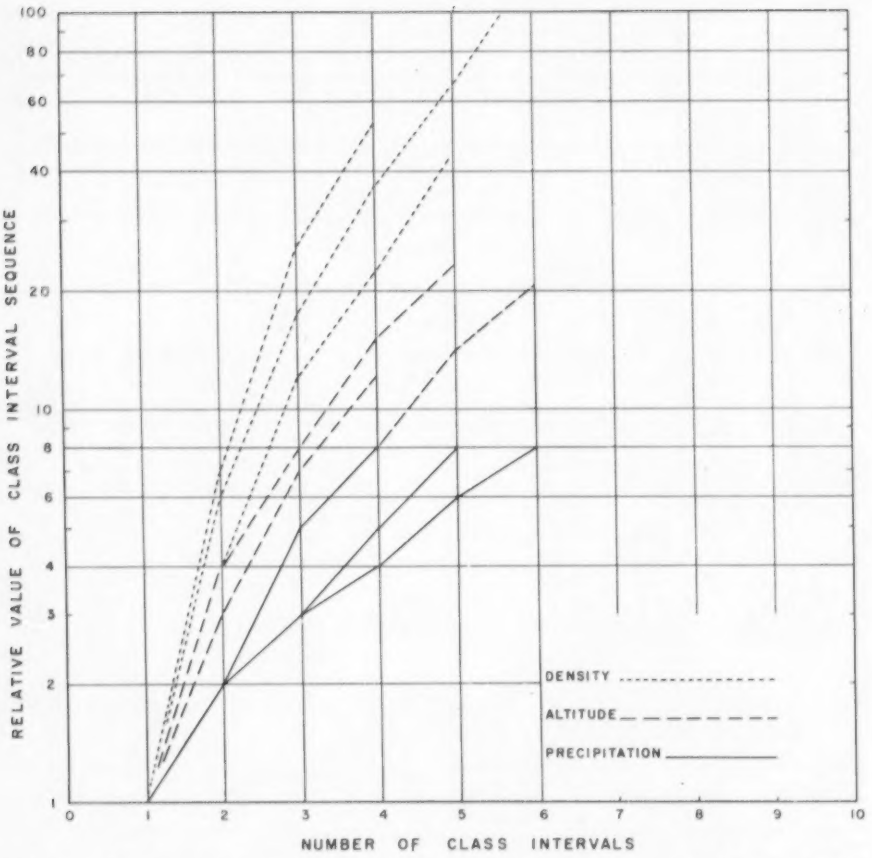

FIG. 4. The curves show averaged figures for density, altitude, and precipitation maps for 4, 5 and 6 class intervals plotted on semi-logarithmic paper (see text). For example, the averaged precipitation curve with 6 class intervals has relative class interval values at 0–1–2–3–4–6–8. Such a sequence is typical of many precipitation diagrams, e.g., 0–10–20–30–40–60–80 when expressed in inches, or 0–25–50–75–100–150–200 when expressed in centimetres. The density curves have the steepest slopes, and they show that the general tendency is to increase the class intervals towards the high end of the scale. The altitude curves approximate a geometric progression which is a straight line on semi-logarithmic paper. The precipitation curves lie between a geometric and an arithmetic progression.

tend to have relatively low densities, low altitudes, and moderate precipitation with small areas having relatively high densities, great altitudes, and heavy precipitation.

ARITHMETIC, GEOMETRIC, AND RANDOM INCREASES

A uniform arithmetic increase such as 0–10–20–30–40–50 is represented in the simplified form by 0–1–2–3–4–5. Since few isopleth or choropleth maps have more than ten intervals, the highest number in the simplified sequence rarely exceeds 10. On semi-logarithmic paper an arithmetic increase is shown as a gradually flattening curve whose rate of change is decreasing. Arithmetic increases are not commonly used for a large range in statistical data, because

it is then impossible to show any small but significant changes at the low end of the scale. For example, if the population density in an area varies from 1 to 1000 people per square mile, a change of 50 per square mile is probably more significant—and certainly represents a vastly greater proportional increase—at the low end of the scale than at the high end.

The majority of scales combine the general features of arithmetic-geometric or random-geometric sequences. Arithmetic progressions are more commonly used at the low end of the scale and geometric progressions at the high end of the scale. Random sequences are frequently combined with arithmetic and geometric progressions at either end of the scale.

Number of Class Intervals

A perusal of geographical literature has shown that few isopleth and choropleth maps have more than ten class intervals. The limitation on the number of class intervals is restricted by at least three factors: simplicity in drafting, ease in reading, and the nature of the statistical data.

Most isopleth and choropleth maps in books and periodicals are reproduced in line drawings and not in color. If there were many more than ten intervals, line drawings would be hard to draft. On an average page-sized map, forty or fifty isopleth intervals would present a picture of utter confusion for the lines would be packed very closely together and the confusion would be compounded if patterns were used between the lines.

When black and white patterns (dots, cross hatchings, etc.) are used on choropleth maps or between isopleth lines, legibility alone dictates against the use of a large number of distinctive patterns. Even if many patterns could be drawn successfully on a map, the utility of such a map would be low, because readers would have to refer constantly back and forth between map and legend in order to interpret the map.

Lastly, the nature of the statistical data rarely justifies many class intervals. To give an extreme case, it would be cartographically possible by extensive interpolation to prepare a large scale isopleth population density map of Canada with a uniform class interval of one per square mile. Such a map would obviously convey a false impression of high accuracy since the statistical data would not permit such a minute interval.

Guide Curves for Class Intervals

Theoretical guide curves for class intervals are shown in Figure 5. The curves are not intended to indicate the precise values of the class intervals for any set of statistical data but rather to suggest what possibilities are available. Indeed, they have more of a theoretical interest than a practical value, although they may serve the latter purpose. The shapes of the curves are predicated upon a number of assumptions which might reasonably be considered to apply to a substantial proportion of isopleth and choropleth maps: (1) the maximum practical limit for the number of class intervals is about ten; (2) regularity in class intervals is preferable to irregularity, and therefore smooth curves to uneven ones; and (3) class intervals should generally remain constant or increase up the scale rather than decrease, so the resulting curves will tend to be convex rather than concave when plotted on semi-logarithmic paper. If these three broad assumptions are granted, then the general shapes of the theoretical guide curves logically follow.

The X axis of Figure 5 gives the

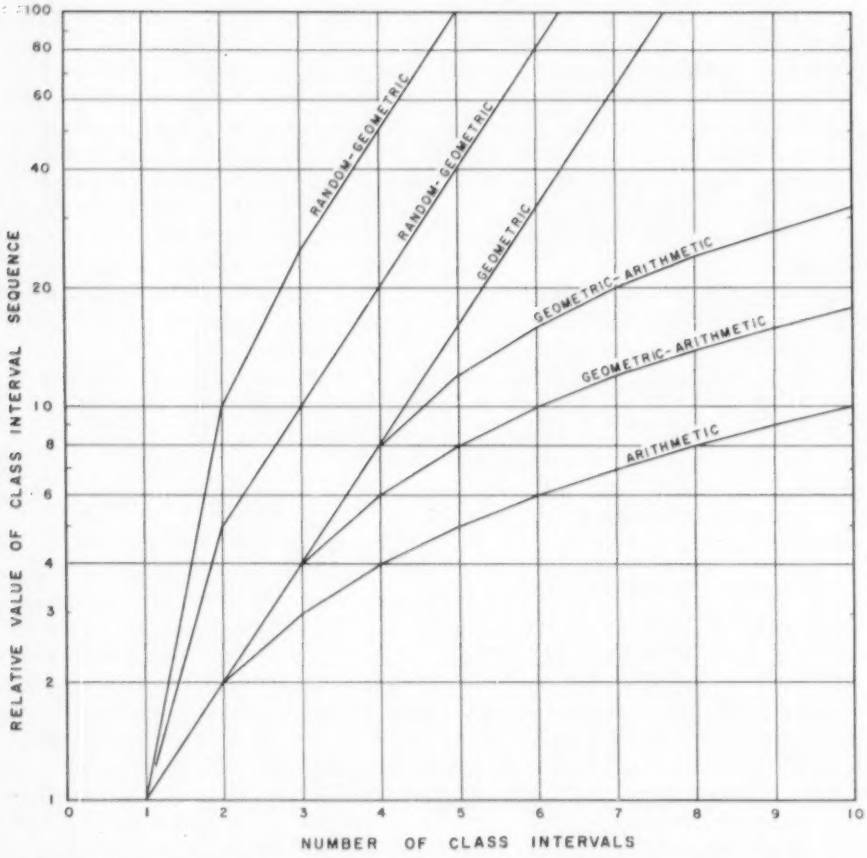

FIG. 5. Theoretical guide curves for testing class intervals are shown on the graph. Although only a few sequences will conform exactly to the theoretical curves, a substantial proportion of the curves for isopleth and choropleth maps will approximate the over-all pattern.

number of class intervals and the Y axis the relative value of the class interval sequence or scale when the first class interval is reduced to the unit value of one. To illustrate the use of the guide curves, let us consider the preparation of a choropleth map where it is desired to have 0 to 5 as the range of the first class interval and the highest choropleth value to be shown is 300. When the first class interval is reduced to 1, the highest value on the Y scale is therefore 60. The graph suggests the following possibilities: a random-geometric sequence if 2 to 6 class intervals are used; a geometric sequence with 7 class intervals; and a geometric-arithmetic sequence with 8 to 10 class intervals. It need hardly be emphasized that the actual curve representing the sequence which is used for a map will often cross one or more of the theoretical guide curves but on balance, the guide curves approximate a substantial proportion of the sequences used in isopleth and choropleth maps.

Summary and Conclusions

Probably the most important problem which the cartographer must face in using isopleth and choropleth maps is the selection of the class intervals. Since it is generally undesirable to select such intervals by mere visual inspection of the statistical data, judgment must be based upon graphic techniques and other aids. The use of frequency, cumulative, and clinographic curves may assist the cartographer to select class intervals which expressively interpret significant distributional patterns. Few isopleth and choropleth maps have more than ten intervals. For most geographical purposes, the first class interval is the smallest. When the scales or sequences of class intervals are reduced to a common denominator by equating the first class interval to one, the sequences can be tabulated, graphed, and compared. Theoretical guide curves can be drawn to suggest the general limits for class interval scales.

COMPARATIVE AGRICULTURAL POTENTIALS OF THE WORLD'S REGIONS

Stephen S. Visher

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THE more adequate knowledge of all parts of the world, which is almost universally recognized as desirable, requires innumerable detailed local studies. The value of local studies is much augmented by wise generalizations based on them. All generalization is risky; unwise generalizations are distinctly harmful if they are widely accepted. However, even faulty generalizations are stimulating to further research and to comprehension.

Generalizations as to the value of other regions have been made since mankind first became acquainted with more than his home locality. The judgments have become increasingly valuable as knowledge has accumulated.

The present provisional classification of the world's regions as to their agricultural potentials is an extension and elaboration of a study presented before the International Geographic Union at its meetings in August, 1952. There, the 80 regions were ranked agriculturally according to three criteria: percentage of the land agricultural, average rank of the cropland, and average suitability for choice crops. Here, seven criteria are used: average topographic suitability for agriculture, average soil quality, average warmth adequacy, average precipitation adequacy, average suitability of precipitation time-distribution (seasonal and intensity), weather dependability (including storms), accessibility of markets for the region's agricultural products.

For each of the world's 80 regions here recognized (located in Figure 1), the average rating for each of these seven criteria is given on the basis of an estimate to which numerical values are assigned: 0 = lacking, or nearly so; 1 = poor, little, or low; 2 = medium, average, or fair; 3 = above average, good; 4 = superior, excellent, or large. The eighth column gives the sums of the scores for the seven criteria. The final column gives, in Roman numerals, the approximate tenth of the world's land to which the region belongs according to the sums of the ratings for the seven criteria.

Geographers will disagree concerning each of the many ratings on Table I, and also concerning the boundaries of the 80 regions here used. Various experts will demand additional regions, while others will be willing to combine some of these but would change some of the boundaries. Likewise, personal knowledge of parts of certain regions will lead some persons to rate them considerably higher or lower than is here done as to one or more criteria. Obviously, adequate knowledge to make an approximately correct rating of most of these regions is not possessed by any one, or even by a group of geographers.

The value of this study fortunately does not depend upon the correctness of the provisional ratings assigned. If it

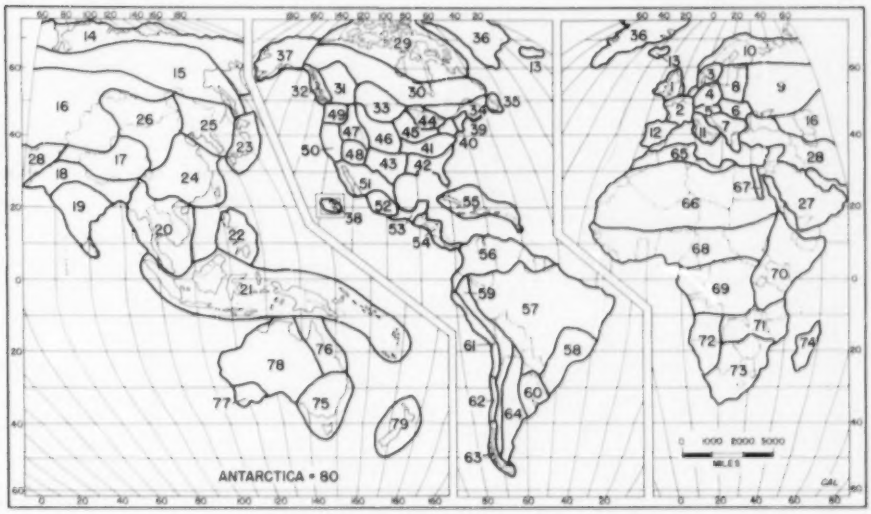

FIG. 1. World Regions.

stimulates interest in regionalization based on average ratings in respect to significant criteria, it will have value. Assuredly such a procedure as is here attempted is more potentially fruitful than are ratings based on impressions, or miscellaneous data, or prejudices, as most earlier comparative ratings have been.

There may be considerable agreement among geographers well acquainted with numerous regions that the regions here placed in the most valuable fifth of the world agriculturally belong there, and that those in the poorest fifth belong in that category. The discussion as to where the remaining regions belong will at least stimulate geographic thought and encourage summarization of regional geographic knowledge.

A comparison of the ratings of the various regions according to the scores on the seven criteria here used may be profitably compared with their ratings on the three distinctly different, less detailed criteria used in the earlier study. The large agreement between these two ratings, independently arrived at, indicates that the criteria are highly significant. Other criteria might advantageously be used; for example, data on average yield per acre of crops and average yield per animal. These data would, however, be less valuable, despite their great utility, than those of the seven criteria here used because such yields reflect the human factors even more than the physical ones. Yields reflect the local level of agricultural science and education, government stimulation, and the effects of imported plant food and animal feed.

The seven criteria here used are mostly of obvious significance. However, the following supplementary statements concerning them have some utility. Topographic suitability for much of the world means gentle slopes. In wet regions, however, level land is unsuitable, while slopes that are more than very gentle are subject to serious soil erosion. In dry regions, where moisture penetration is particularly advantageous, almost level land is especially desirable. Soil

TABLE I—THE EIGHTY REGIONS COMPARED AS TO SEVEN CRITERIA

Also Total Scores and Tenth Scores

Criteria are regional average of (1) topographic suitability for agriculture, (2) soil quality, (3) warmth adequacy, (4) precipitation adequacy, (5) precipitation time-distribution suitability for agriculture, (6) weather dependability, including storms, and (7) accessibility to markets for agricultural products.

Regions	*Topographic Suitability*	*Soil Adequacy*	*Warmth Adequacy*	*Precipitation Adequacy*	*Precipitation Distribution*	*Weather Reliability*	*Market Accessibility*	*Total Score*	*Tenth Score*
EUROPE									
1. British Isles	3	3	3	4	3	4	4	24	I
2. France	3	3	3	3	3	3	4	22	I
3. North Sea Borders (part)	4	3	2	4	3	4	4	24	I
4. Germany	3	2	3	4	3	3	4	22	I
5. Switzerland and Austria	2	2	2	4	3	3	4	20	II
6. Other Central Europe	2	2	3	3	3	3	4	20	II
7. The Balkans	1	2	3	2	2	2	3	15	VI
8. Poland, etc.	3	2	2	3	3	2	3	18	III
9. Russia proper	4	3	2	2	3	2	2	18	III
10. Subarctic Europe	2	0	0	2	1	1	1	7	IX
11. Italy	2	2	3	2	2	2	4	17	IV
12. Spain and Portugal	3	2	3	2	2	2	3	17	IV
13. Iceland	1	0	1	2	1	1	2	8	IX
ASIA									
14. Tundra	1	0	0	2	1	1	0	5	X
15. Taiga	2	1	1	2	1	1	1	9	IX
16. Steppe	3	3	2	1	2	1	1	13	VII
17. Tibet	1	0	1	1	1	1	0	5	X
18. North India	3	3	4	2	3	2	3	20	II
19. Other India	2	2	4	2	3	2	2	17	IV
20. S. E. Asia	2	2	4	2	3	2	2	17	IV
21. East Indies	2	2	4	3	3	2	2	18	III
22. Philippines	2	2	4	3	3	2	2	18	III
23. Japan	1	2	3	4	3	3	3	19	II
24. China proper	3	3	3	2	3	2	2	18	III
25. Manchuria	2	2	2	2	3	2	2	15	VI
26. Mongolia	2	2	2	1	2	1	1	11	VIII
27. Syria-Arabia	2	2	3	1	1	1	1	11	VIII
28. Other S. W. Asia	2	2	3	1	1	1	1	11	VIII
NORTH AMERICA									
29. Tundra	1	0	0	2	1	1	0	5	X
30. Taiga	2	1	1	2	1	1	1	9	IX
31. W. Canadian Mountains	1	2	2	2	2	2	1	12	VIII
32. N. Pacific Coast	1	1	2	3	2	4	3	16	V
33. Springwheat Belt	3	3	2	2	3	2	2	17	IV
34. S. E. Canada	2	2	2	3	3	3	3	18	III
35. Newfoundland	1	1	1	3	2	2	2	12	VIII
36. Greenland	0	0	0	1	1	1	1	4	X
37. Alaska	1	1	1	1	1	1	1	7	IX
38. Hawaii	2	3	4	2	3	3	2	19	II
39. New England	2	2	3	3	3	4	4	21	I
40. Mid-Atlantic States	2	2	3	3	3	3	4	20	II
41. The Upper South	2	2	3	2	3	3	3	18	III
42. E. Gulf Coast and Florida	3	2	4	2	2	2	3	18	III
NORTH AMERICA (cont'd)									
43. Texas	3	2	3	2	2	2	2	16	V
44. Great Lakes Region	3	2	3	3	3	3	4	21	I
45. The Midwest	4	4	3	3	3	3	4	24	I
46. Central Great Plains	4	4	2	2	4	2	2	20	II
47. W. Mountains and Plateaus	2	2	2	2	2	2	2	14	VII
48. Arid South-West	2	2	3	1	2	1	2	13	VII
49. The N. W. States	2	2	3	2	2	3	3	17	IV
50. California proper	2	3	4	2	2	2	3	18	III
51. Arid Mexico	2	2	3	1	1	1	1	11	VIII
52. Mexican Plateau	2	2	2	1	2	1	2	12	VIII
53. Mexico, Humid Lowlands	3	1	3	2	3	3	1	16	V
54. Central America	2	1	3	3	3	3	1	16	V
55. West Indies	3	2	3	3	3	2	3	19	II
SOUTH AMERICA									
56. Northern S. America	2	1	3	3	2	2	2	15	VI
57. Amazon Lowland	2	1	3	3	2	2	1	14	VII
58. Brazilian Plateau	2	2	3	3	3	3	1	17	IV
59. Andes Mts. and Plateau	1	1	1	2	2	1	1	9	IX
60. River Platte Region	4	4	3	3	3	3	2	22	I
61. N. Chile–W. Peru	2	2	3	1	1	1	1	11	VIII
62. Central Chile	3	3	3	2	2	2	1	16	V
63. Southern Chile	1	2	2	3	3	3	1	15	VI
64. Patagonia	2	2	2	1	1	1	1	10	VIII
AFRICA									
65. North Africa	2	2	4	2	1	2	3	16	V
66. The Sahara	2	1	3	1	1	2	1	11	VIII
67. Nile Egypt	4	4	4	0	0	2	3	17	IV
68. Sudan and West Africa	3	2	3	2	2	1	2	15	VI
69. Congo Basin	2	1	3	3	3	2	1	15	VI
70. E. African Uplands	2	2	3	2	3	2	1	15	VI
71. S. African Plateaus	2	2	3	2	2	2	1	14	VII
72. Arid S. W. Africa	2	2	3	0	0	1	0	8	IX
73. South Africa	2	3	3	2	2	2	2	16	V
74. Madagascar	2	2	3	2	2	2	1	14	VII
AUSTRALASIA									
75. S. E. Australia	2	3	3	2	2	2	2	16	V
76. N. E. Australia	2	2	4	2	2	2	1	15	VI
77. S. W. Australia	3	3	3	2	2	2	1	16	V
78. Arid Australia	2	2	2	1	1	1	0	9	IX
79. New Zealand	2	2	3	2	2	3	1	15	VI
80. Antarctica	0	0	0	1	1	1	0	3	X

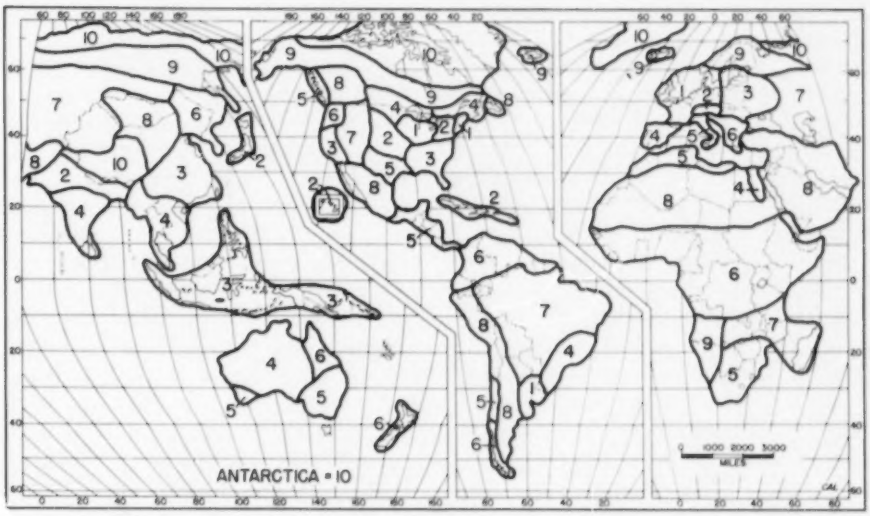

FIG 2. Agricultural Potentials of the World Regions based on 7 criteria. 1 = the highest average; 10 = the lowest average.

suitability reflects fertility, texture, depth, resistance to erosion, and rate of rejuvenation. Some soils deteriorate rather quickly when tilled, while certain others resist much abuse. The soil of much of the world is poor as compared with soils classed as fair in the United States.

Sufficient warmth is a prerequisite for agriculture, but it is coming increasingly to be realized that high temperatures are distinctly harmful to many crops and farm animals. Indeed for most of the world's more valuable crops and farm animals, temperatures above 80° F. are harmful. Thus, despite popular belief to the contrary, tropical areas are undesirably warm for crops. Conversely, temperatures below about 50° reduce most plant growth so drastically that regions lacking temperatures warmer than that during a considerable share of the year, at night as well as average of day and night, are seriously handicapped agriculturally.

Precipitation is a major agricultural requirement, except where irrigation is practiced. The amount of precipitation needed depends on the rate of evaporation, the crop grown, the topography, soil, and, especially, on how the rain falls.

The time distribution of the precipitation is so important that a special rating is here made as to it. Seasonal distribution and intensity are especially significant. Where much of the rain falls in sudden downpours at irregular intervals, it is far less useful for agriculture than where it falls gently at regular intervals. The effects of "cloudbursts" and of hard winter rains upon runoff and on soil erosion are impressive.

Weather dependability also has great agricultural significance. Storms, drouths, wet spells, cold spells, hot spells, high winds, hail, lightning, and unseasonable weather are aspects considered in rating the regions as to weather. This criterion significantly supplements the three earlier ones which are climatic.

Accessibility of markets for the agri-

cultural products is a highly significant criterion as to the comparative value of regions. It varies with political as well as geographic location, but, in the ratings here given, political factors such as tariffs are ignored.

Figure 2 shows the location of the various tenths of the world agriculturally based on these criteria as here estimated. The better lands are in western Europe, northeastern United States, the River Platte region of South America, Northern India, and Japan. The poorer lands are the polar and sub-polar regions, the deserts that can not be irrigated, and Tibet.

Study of the details of Table I and Figure 2 will afford some surprising deductions. Evidence that appears to critics to outweigh that here used will be welcome. Surely there is dire need for better evaluation of all parts of the world. And, although inadequate knowledge is now available, what better way is there to encourage the improvement of the evaluation than to present an evaluation like this for discussion and as a challenge to others?

THE STATUS OF AMERICAN GEOGRAPHY: A REVIEW

Charles A. Fisher

Mr. Fisher is Lecturer in Geography at University College, Leicester, and editor of the new magazine, "Geographical Studies."

GEOGRAPHERS in all parts of the world will rightly regard *American Geography: Inventory and Prospect*[1] as marking a major milestone in the evolution of their discipline. For the first time in the history of geographical scholarship a conscious attempt has been made to sum up the results hitherto achieved by the profession in one country and, on this basis, to seek guideposts for the future. Although it was not originally intended as an anniversary volume, the appearance of the book has in fact coincided with the semi-centennial of the Association of American Geographers which is a peculiarly apt occasion for such a stocktaking of the work of two generations of pioneers.

As is abundantly clear, from the list of content onwards, this is essentially a cooperative effort, not merely in the sense that nearly all of the 26 chapters have been contributed by different authors but also in that most of the latter acknowledge the active collaboration of one or more colleagues in the preparation of their original drafts. Thus, although its editors modestly state that the book makes no claim to have covered all phases of American geography or to reflect all shades of current American geographical opinion, it would be difficult to imagine a more representative or more comprehensive compilation within such manageable compass.

Nevertheless, scholarship by committee has its limitations and some, at least, of these are evident in this work. Thus, the search for compromise and catholicity has tended to conceal the existence of different schools of thought, and one could wish for a fuller treatment of the distinctive points of view which are associated with the major centers of geographical study in the United States. Again, not all of the authors have interpreted their terms of reference in the same way, and, indeed, it is not wholly clear from the foreword whether the main purpose is to "consider concepts or basic generalizations that have been used in professional geographic work" or to provide "a progress report on the objectives and procedures of geographic research as of January 1954." The result is that, whereas in some chapters, for example the admirable studies of historical geography (Andrew H. Clark) and political geography (Richard Hartshorne), the emphasis is on concept and methodology, some of the other contributors, doubtless in a generous attempt to leave no one without a memorial, have recorded with great thoroughness the work of innumerable fellow specialists but have made correspondingly less attempt at interpretation or assessment.

Furthermore, even if with Preston E. James we reject the false duality of

[1] *American Geography: Inventory and Prospect*, Edited by Preston E. James and Clarence F. Jones. xii and 590 pp.; maps, ills., lists of references by chapters, index. Published for the Association of American Geographers by Syracuse University Press, Syracuse, N. Y., 1954. $6.50. 9 x 6 inches.

regional as opposed to topical geography, we may well doubt whether the former, of which he himself is so notable an exponent, has received anything like the coverage it merits in a book nearly all of whose chapters are avowedly topical. Indeed, since even the excellent but solitary "regional" chapter (Derwent Whittlesey) is in fact concerned almost exclusively with an analysis of concept and method, we are left without any real indication of what the major American contributions to regional geographic literature have been. In the reviewer's opinion one of the most significant aspects of any nation's geographical work is the extent to which study of the home area has helped or hindered the achievement of that wider "world view" which it is the supreme task of the geographer to inculcate. In the case of the United States, whose history and current position of world leadership alike pose unique problems, some consideration of this matter of comparative regional emphasis would have been particularly illuminating.

It is, indeed, on such broader issues as these that the book, because of its composite authorship, is least satisfying. Notwithstanding the arresting opening remark that "Geographic scholarship in the United States has a history which closely parallels that of the republic itself," the rich potentialities of this theme are scarcely developed at all, and, apart from an occasional reference such as that on page 260 to the distinctively American emphasis on the intensive field study of small areas, the even more stimulating topic of the geography of geographic scholarship is almost completely ignored. Yet in view of the unique coloring which geographical studies have assumed in individual countries, notably France and Germany, it would seem that this is a problem which should at least have received some evaluation in so exhaustive a stock taking. Surely, a consideration of what is distinctively American in American geography need not have been debarred on the grounds of the provincialism which the editors so justly decry in their foreword.

In fact, of course, as a perusal of this work will make clear, geographical study in the United States has many distinguishing features. Perhaps the most readily apparent of these, as revealed in the present volume, is the extent to which topical specialization is now being carried. Altogether some 20 kinds of topical geography receive attention, and, as is frequently stated or implied, this list makes no pretense at completeness. While there is no reason to doubt that, in one way or another, all the fields here examined are worthy of cultivation, questions may reasonably be asked as to whether each is quite so distinctive as some of its advocates assume and whether such rigorous fragmentation represents an unqualified gain for the cause of geographical scholarship. For if, as is pointed out in the introduction, "geography is still the field that deals with the *association* of phenomena that give character to particular *places* and with the likenesses and differences among places" (reviewer's italics), it is at least arguable that any further narrowing down along purely topical lines will take the geographer away from rather than towards his goal.

It is, again, significant that the process of specialization seems to have been carried farthest in respect of economic geography. For while there may be truth in the contention that no scholar can pretend to competence in all the technicalities of production, transportation, and exchange, it is equally true that the subdivision of economic geography into five or six main components

is a reflection of the extremely heavy emphasis on the economic aspects of geography which has long been another distinctive characteristic of the American approach to the subject. But if, as Raymond E. Murphy contends, "general economic geography has ceased to exist as a research specialty" we may perhaps be permitted to lament its passing. For the need still remains for researchers in all branches of this field to endeavor to see the economy as a whole and to take cognizance of those regional variations in this totality which it is a major task of the geographer to evaluate.

Thus while all will doubtless agree that the present generation of American economic geographers has made a great step forward in abandoning the stereotyped study of commodities and trade routes, which was current throughout the English-speaking lands not long ago, and concentrating instead on a far more penetrating analysis of the geographical patterns formed by the component strands which make up a region's economy, it is equally important that these studies should be seen in perspective as parts of a greater whole and not simply as ends in themselves. Fortunately there are several indications that such an awareness exists as, for example, in the chapters on the geography of manufacturing (Chauncy D. Harris) and urban geography (Harold M. Mayer).

From many points of view, the latter is one of the most interesting contributions of all, not least on account of its portrayal of specifically American variations in problems common to all parts of the world and the deep understanding which it reveals of the particular contribution that the geographer can make to their solution. The observation that "geographers are more interested in the deviations from a general formula as they develop under the circumstances of particular places" is typical of the many stimulating conclusions which this chapter contains. Much the same deduction seems also to be drawn from Edward L. Ullman's examination of "geographic theory and social physics" in the thought-provoking chapter on transportation geography.

Considerations of space forbid any detailed examination of the material contained in the sections of the book which deal with the various aspects of physical geography, though this in no way implies any lack of appreciation of either their importance or their merit. Indeed, there, as elsewhere, one is repeatedly impressed by both the range and the practical significance of the investigations which are today being pursued by members of the American geographical profession.

It is above all on account of its sense of abounding vitality in exploring new approaches and experimenting with new techniques that American geography, as portrayed in this volume, seems so stimulating to the outsider. Throughout the whole book there is evidence of a common realization that the time has come to sort through the accumulated data of the past 50 years, to arrange them into more meaningful forms, and, on the basis of work already accomplished, to put forward new generalizations and to formulate new concepts.

In this respect, great interest attaches to the notion of "compages" outlined in the chapter on regional method. While it is desirable to restrain the proliferation of jargon for its own sake, it seems clear that some of our established terminology has become so confused as to be of doubtful value for further scientific work. For this reason we may welcome both the use of the new term to describe "the type of region differentiated as to

human occupance" and the suggestion that an accepted hierarchy of compages, to include locality, district, province, and realm, should be recognized by all geographers. Clearly, however, a great deal of further discussion and research will be needed before general agreement can be reached on this matter. Thus, for example, it may not be without significance that the two instances "arbitrarily cited from Europe and Asia" for a demonstration of this terminology should in fact be the Paris Basin and the Red Basin of China, two areas of close settlement in which the process of "differentiation as to human occupance" has reached an advanced stage. But to what extent is the same hierarchy appropriate to areas of sparser and more recent settlement, devoid of any well established regional capitals, such as, let us say, the northern two-thirds of Canada? Here, it would seem, is the sort of question on which North American geographers, by virtue of their own experience, should have a special contribution to make, and it is certainly one which lies at the very core of the subject.

So long as there is agreement regarding the central aims and purpose of the discipline, any disputes over the delimitation of its boundaries are of minor consequence. Thus, while some of us may perhaps doubt whether the case for marketing geography amounts to anything more than good salesmanship of applied geography to the American business community, we may well applaud such a venture on the grounds that this is a right and proper field for the employment of qualified geographers.

Similarly, the argument will doubtless be heard that medical geography derives more from, and renders greater service to, medicine than geography. But, as Dr. May's findings show, it is no less valuable on that account, and, indeed, if the application of even a relatively small part of the geographer's training can contribute materially to the conquest of disease it is a cause for the utmost satisfaction.

In the long run it will surely be through proving its relevance to an understanding and mastery of the complex problems inherent in mankind's relationship to the world he lives in that geography will most effectively justify its place in both the academic and the practical realm. That such a position can now be claimed with assurance this book provides abundant and irrefutable evidence.

BOOK REVIEWS

Sukumaland: An African People and Their Country, by D. W. MALCOLM. xviii and 224 pp.; maps, ills., tables, glossary, bibliogr., index. Published for the International African Institute by the Oxford University Press, London, 1953. $5.25. 8¾ x 5½ inches.

Sukumaland is a region comprising 20,000 square miles immediately south of Lake Victoria, East Africa. Its million rural people constitute the northern branch of a large tribe. Currently it is in process of changeover from shifting cultivation to sedentary agriculture with some commercial production, in a habitat sufficiently uniform to present a single range of problems and solutions. The transformation in land use—one of major scope—is being carried out by a federation of local chiefdoms achieved in 1946 at the suggestion of British administrative officials. This new scaffolding of government is being erected upon indigenous practices so far as possible and is therefore proving adaptable to novel needs as they arise. It operates with a minimum of African and European personnel, thus keeping the administrative structure sufficiently light-weight to be supported within the means of the population.

Because the Sukuma and their land make up an integrated geographic unit of moderate size, the account of what is going on can be detailed and specific to a degree unattainable in studies covering regions larger or more diverse. The author began his work two decades ago, and he traces internal migrations and changes in land use during that period as background for his depiction of the present status and future prospects. In choosing to focus his study on land use he has produced a realistic and absorbing work in geography. The inhabitants consistently appear at the center of his portrait, but never in isolation. They are shown as occupiers of a natural environment in which customary practices have produced a coherent economic, social, and political existence. That traditional order has been and continues to be modified through foreign agencies, Arab and European. A salient outcome of recent decades has been rapid increase in population, and this has made it imperative to devise a mode of land use that can sustain the mounting demands without destroying the natural endowment on which the essentially rural economy must be based.

All the facts of community living in Middle Africa are kept within the lay reader's view and comprehension. Technical matters needed by specialists are available in appendices. Names in the local language that must be employed because they have no suitable English equivalents are defined in a glossary. A detailed table of contents, supplemented by a full index, provides a ready guide to the book's contents.

Amid the current spate of books about Africa as a whole or in its larger parts, *Sukumaland* deals with a small unit and may appear to be confined to an insignificant fragment of African land and African people. Such a conclusion would be in error. By so confining it, the author exemplifies and epitomizes his mastery of the changing interrelations in social structure, density of population, land use, and the very land itself. Similar changes are affecting every region in Africa south of the Sahara, and the parallel is close in those vast expanses where European settlers have not taken land for farming or ranching. Even where European ownership and operation of the land has complicated the transformation of indigenous land use, some guidance is to be found in the experience gained in Sukumaland.

The sponsoring International African Institute deserves high praise for a handsome volume that does credit in both its maps and its text to a work of superb craftsmanship and deep significance for Africa and the world.

DERWENT WHITTLESEY

Harvard University

India and Pakistan: A General and Regional Geography, by O. H. K. SPATE. xxxvi and 827 pp.; maps, diagrs., tables, bibliogr. notes, index. E. P. Dutton & Co., Inc., New York (Methuen & Co., Ltd., London), 1954. $12.75. 9¼ x 6 inches.

India and Pakistan together cover well over a million and a half square miles and in 1951 had a population of about 438 million people. Despite the sub-continent's great size and importance, Spate's book is the only modern geography in English devoted to this area alone. Congratulations are due to Professor Spate for providing a comprehensive and well written text to fill this gap.

The book is divided into four main sections. Part 1 is entitled "The Land" and describes "Structure and Relief," "Climate," and "Vege-

tation and Soils" in 94 pages. Part 2 deals with "The People" and discusses "Population and Its Problems," "The Peoples of the Sub-Continent," "Historical Outlines," and "Village and Town in India" in four chapters totaling 100 pages. Part 3 is called "The Economy," and in 127 pages gives a systematic summary of agriculture, industry, transportation, and trade. The main contribution of Spate's work is contained in Part 4, entitled "The Face of the Land." Here 438 pages are devoted to descriptions of the 35 major regions of India and Pakistan, with one chapter, written by B. H. Farmer, reserved for Ceylon.

The frontispiece has two half tones of a rather poor relief model showing the sub-continent from the north and from the southeast. Unfortunately, there are no other photographs in the book. This is offset by a large number of maps, 160, some of which have been seen before; others have been compiled especially for this work. Many of the maps are clear and easily understood, others require rather concentrated study.

The captions of the maps appearing on pages 212 and 457 appear to be incomplete. The four maps of agricultural products appearing between pages 216 and 222 each contains a symbol which does not appear in the legend; to understand these maps the reader must refer back to the map of rice on page 214. In the chapter "Transportation and Trade" there are two maps of railways but no map of highway distribution, even though as much text is devoted to highways as to railways. The map entitled "The Vale of Peshawar and the Khyber Pass," page 446, falls far short of being the kind of map that gives the student a vivid visual impression. Other maps, such as the several showing settlement patterns and urban areas, are very well done.

The writing is clear and straightforward and the author is seldom repetitious. On many pages Spate rises well above the usual methodical textbook English and presents passages that approach the classic in description. This is especially true in his paragraphs dealing with major urban areas as is shown by the following excerpt from the description of Benares:

"The city lies along the Ganges, on a *kankar* ridge, for about four miles; and the curving river front is lined by great flights of steps, the bathing ghats, and by massive temples, in turn tawdry and splendid. Behind these is a labyrinth of narrow fetid alleys, overhung by tall galleried houses, with innumerable shrines 'ranging from a shapeless fragment of stone smeared with vermilion to magnificent temples.' The streets are crowded with priests, mendicants, and touts, and their pilgrim prey, and through the turmoil the sacred bulls of Siva lounge arrogantly."

India and Pakistan is well documented throughout, a fact which serves to give Western geographers some idea of the vast resources of material available in many of the little known Indian publications. Spate's data are mostly of recent origin, and, even though the major part of the work was finished in April of 1951, many of the population figures are from the 1951 census. Statistics are freely but judiciously used so that the reader is never lost in figures. Seventeen pages of statistical tables are conveniently grouped at the end of Part 3.

Spate's book will enjoy small sales as a required text in America as it is too comprehensive for use in a course designed to cover Asia as a whole and there are few courses restricted to the Indian sub-continent. However, the book is a "must" for any geographer whose interest centers on Asia and it should be required reading of all government, especially State Department, officials whose duties require dealings with India or Indians.

ROBERT E. HUKE

Dartmouth College

Indian Corn in Old America, by PAUL WEATHERWAX. ix and 253 pp.; ills., bibliogr., index. The Macmillan Company, New York, 1954. $7.50. 7¾ x 10¼ inches.

Several men are recognized as the leading scholars in the field of research on maize, or Indian corn. Weatherwax is one of these men. He presents here a simple review of the botanical and ethno-botanical history of this unique plant. The study is rich in history, for Weatherwax has made a point of studying the 16th century sources. It is strong botanically, for that is his principal field.

The historical sources are reviewed, the history of the contact and discovery of corn and its introduction into Europe is related. Corn growing in aboriginal America is described as to where, how, and for what uses. The origin of corn is discussed in terms of the search for wild corn, maize and its relatives, the pod corn problem, and an attempt at a botanical reconstruction of wild maize. A section on what the Indian did to improve corn and of the relation of corn to American Indian cultures follows naturally.

The work is brief and relatively easily understood by the non-botanist, except in a few places in the discussion of wild corn, maize relatives, and the related sections. The bulk of the book is written in a relaxed and readable style. The sections on use and distribution are simply highlights culled from much reading and observation. They aren't intended to be either systematic or to give thorough coverage, but only to indicate the nature of the material.

There is considerable controversy in the "corn field" concerning the origin of maize historically and botanically. Weatherwax is a protagonist and frankly presents his own views

with little attempt to give an unbiased version of the other man's view. His strictures on Anderson's views of the origin of corn are a good example. Anderson has been extremely careful to point out possibilities but to avoid leaping to conclusions concerning an extra American origin for maize. Anderson *has* presented some powerful evidence suggesting the pre-Columbian presence of maize outside America. As of this moment, rumors reach my desk of maize in Africa at 1000 A.D. and of maize pollen in the Pleistocene of Mexico. This new evidence if eventually accepted would show Weatherwax to be both right and wrong. His thesis of an American origin of corn would be supported by the evidence of the presence of corn in America during the Pleistocene. But Anderson's thesis of the presence of corn outside America long before 1500 would be supported by the African data. Knowledge is like that. Facts are forever obtruding to disturb hypotheses. The reader is warned to be slow to take sides. But he can learn a lot about corn relatively painlessly if he will read this little book with no more than the usual allowances for the author's personal views.

GEORGE F. CARTER
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Erde und Weltwirtschaft. Ein Handbuch der allgemeinen Wirtschaftsgeographie. Edited by RUDOLF LUETGENS. Franck'sche Verlagshandlung, Stuttgart.

Vol. 1: *Die Geographischen Grundlagen und Probleme des Wirtschaftslebens*, by R. LUETGENS. 270 pages, 197 text figures, bibliography. Stuttgart 1950. Linen, 24 DM. 7 x 10 inches.

Vol. 2: *Die Produktionsraeume der Weltwirtschaft*, by R. LUETGENS. 255 pages, 88 text figures, statistical appendix, index, bibliography. Stuttgart 1952. Linen, 28 DM. 7 x 10 inches.

Vol. 3: *Allgemeine Agrar- und Industriegeographie*, by ERICH OTREMBA. 341 pages, 90 text figures, bibliography, index, 16 air photo plates. Stuttgart 1953. Linen, 36 DM. 7 x 10 inches.

The appearance of the third volume of this new German "handbook of general economic geography," might be the right moment to present a first comment on the work. Although written in German—and in quite heavy German in places—any American geographer interested in methodological aspects of the field should put it on his compulsory reading list.

The volumes represent quite typically the recent trend established by leading European economic geographers: to get away from the commodity approach (*Produktionsgeographie*) by focusing on areal units as determined by economic activities of man. "A clearing in a tropical forest as well as downtown New York are mirrors of economy, and our task is to study the economic landscape as the expression of economy"—these words from Boesch's *Wirtschaftslandschaften der Erde*, based on similar methodological principles, best express the goal of the "landscape method" in economic geography.

In practice, this goal has never been achieved and it isn't in these volumes, either. On the contrary, one must be rather disappointed to find a final synthesis in which "the two main economies of agriculture and industry are to be areally united" (*die beiden Hauptwirtschaftsformen der Landwirtschaft und Industrie sollen zur raeumlichen Einheit zusammengefuehrt werden*) presented on a mere nine pages. Here, ten principal economic formations (*Hauptwirtschaftsformationen*) are differentiated, and they also represent the criteria for the delimitation of economic areas. (*Wo sich das Gefuegebild der Wirtschaftsformen aendert, liegen die Grenzen des Wirtschaftsraumes.*) No map is given of the areal extent of the established formations which indicates to this reviewer that the "landscape idea" has not been adhered to consistently. Besides, the criteria used in the delimitation of the economic formations are too heterogeneous to assure a balanced classification. What is the *tertium comparationis* for such formations as "the oases," "settlement colonies" (Australia, Canada), or "peasant regions with local industries and raw material production for the world market" (Southeast Europe and Southeast Asia)? It is surely a huge task to integrate agricultural and industrial as well as social and marketing characteristics in one system—as a basis for discussion, however, it fulfills an important function.

Looking over the individual volumes, in the first, one finds a masterful analysis of physical and cultural factors and their effect on economic activities. A multitude of examples illustrates the interrelation between environment and economy in all parts of the world. Fifty pages alone are dedicated to a discussion of climate, some 20 pages show influence of landforms on settlements and communications. The first volume actually sets the stage for the second in which "the terrestrial regions are treated as wholes—not only under the viewpoint of economy." Resorting to Passarge's landscape belts Luetgens shortly treats the physical and human constituents of each "realm" (*Wirtschaftsraum*) and then proceeds to the various phases of economy. Smaller regional units are singled out after a rather subjective scheme in which climatic and political boundaries seem to play a greater role than economically relevant breaks.

In Volume 3, Erich Otremba, successor of Luetgens at the University of Hamburg, presents a systematic treatment of agrarian and industrial geography. Skillfully applying the

principles of comparative geography, the author leads us through a very complex field of geography in which such items as house types, field patterns, laborer migrations, land use mapping methods, etc., constitute objects of study. This volume undoubtedly is a treasure of methodology, it is a handbook in which research tools are abundantly presented.

The regional treatment, i.e., the one of individual "economic landscapes," is restricted to a few selected examples of which only northwestern Europe receives more than summarizing attention. If one takes pains, however, with paging through all three volumes for references to northwestern Europe one will find a great deal of information about this region—if only there were a better index to help find the pieces for the mosaic!

As far as the classification of manufacturing industries is concerned, a criticism similar to the one made in the case of economic formations must be voiced. Again, the classificatory criteria are ambiguous and the remark that "it is undoubtedly allowed to digress once in a while from methodological viewpoints" is not easily forgiven in the prevailing methodological environment of the whole work. One may agree that the heavy industry on one side, the textile industry (the "light" industry of the Russian language) on the other are significant types, while designations such as "great cities" industries, industries of harbors and "river alleys," and *Mittelgebirgsindustrien*—industries located in old subdued mountain systems such as the Appalachians—are rather naive.

Although statistics are brought up to 1950 in the appendix the same should have been done in the text and particularly in some figures. U. S. Pipe Line and Highway maps of the twenties look rather archaic. Symbols on commodity distribution maps are too small and some are misplaced (Upper Iraq oilfields, Bauxite in the U. S.). A dot map of the Yellow Race in the United States is entirely misleading through the distribution of dots over state areas instead of in urban agglomerations only. There is no bauxite production in Canada and it is at least a questionable statement that the Southern United States is "fully used by man in any respect." And last but not least: may the authors eradicate a vast amount of misspellings in English nouns (I/p. 265, III/266) in a second edition.

In conclusion, it should be emphasized that the series—to be continued with *Handels—und Verkehrsgeographie* and *Der Mensch als Gestalter der Erde*—will make a basic contribution to the literature of economic geography. Putting the volumes back on the shelf one has the feeling of having taken part in the renaissance of a science—or an art. Drawing the picture of the economic landscape is both.

DIETER BRUNNSCHWEILER
Clark University

NEW EDITIONS

Brazil—People and Institutions, by T. LYNN SMITH. Revised. xix and 704 pp.; maps, charts, tables, ills., bibliogr., index. Louisiana State University Press, Baton Rouge, La., 1954. $7.50. 9¼ x 6¼ inches.

Chisholm's Handbook of Commercial Geography, by L. DUDLEY STAMP and S. CARTER GILMOUR. 14th edit. Entirely rewritten. xiii and 915 pp.; maps, diagrs., tables, index. Longmans, Green and Co., Inc., New York, 1954. $12.75. 5½ x 8½ inches.

Economic Geography, by CLARENCE F. JONES and GORDON G. DARKENWALD. Revised. xxv and 612 pp.; maps, diagrs., charts, tables, ills., chapt. refs., index. Macmillan Co., New York, 1954. $6.75. 9½ x 7 inches.

Elements of Political Geography, by S. VAN VALKENBURG and CARL L. STOTZ. 2d edit. xvi and 400 pp.; maps, diagrs., tables, bibliogr., index. Prentice-Hall, Inc., New York, 1954. $5.90. 8¾ x 5¾ inches.

A Geography of Europe, by JEAN GOTTMANN. 2d edit. xii and 724 pp.; maps, diagrs., charts, ills., bibliogr., index. Henry Holt & Co., New York, 1954. $6.90. 9¼ x 6¼ inches.

Geography of North America, by GEORGE J. MILLER, ALMON E. PARKINS, BERT HUDGINS. 3d edit. xi and 664 pp.; maps, diagrs., charts, tables, ills., bibliogr., and index. John Wiley & Sons, Inc., New York, 1954. $7.50. 9 x 6 inches.

The Pacific Northwest, by OTIS W. FREEMAN and HOWARD H. MARTIN. 2d edit. xvi and 540 pp.; maps, diagrs., tables, ills., refs., index. John Wiley & Sons, New York, 1954. $8.50. 9 x 6 inches.

The Statesman's Yearbook, 1954, 91st annual publication. xxiv and 1608 pp.; maps, tables, index. St. Martin's Press Inc., New York, 1954. $8.50. 7½ x 4¾ inches.

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